A Day in the Life of a Beaumont Laboratory Medical Laboratory Scientist
Module Purpose

To provide School of Medical Laboratory Science applicants and students an *in-depth* view of the daily roles of medical laboratory scientists (aka medical technologists) employed by the Beaumont Laboratory Department of Clinical Pathology on the Beaumont Hospital, Royal Oak campus.
Objectives

Upon reviewing this presentation, the MLS applicant and/or student will be able to:

1) Describe the daily responsibilities of a medical laboratory scientist in each major discipline.

2) Appreciate reflections about the career as shared by clinical instructors in the Beaumont School of Medical Laboratory Science.

3) Respond to questions related to this information at the interview and/or program orientation.
• Among the highest test volume hospital-based laboratories in the country, more than 10 million specialized and routine tests are performed annually.

• The various laboratories are located in the Research Institute building and the Main Hospital.

• Staff include: 12 M.D. pathologists, 5 bio-scientific Ph.D.’s, 200+ certified medical laboratory scientists, and approximately 100 phlebotomists, clerical and specimen processing assistants.
Clinical Pathology

- The clinical laboratory at Beaumont Hospital, Royal Oak is called Clinical Pathology.

- Laboratory professionals use sophisticated, biomedical instrumentation, technology, and computers - as well as various manual methods - to perform the thousands of currently available laboratory tests.

- Fact: 70-80% of patient care decisions are based on the results of laboratory testing.
Clinical Pathology Laboratories include:

- Blood Bank
- Chemistry
- Hematology
- Special Testing & Immunology
- Coagulation
- Microbiology
- Flow Cytometry
- Molecular Pathology
- Phlebotomy
- Ancillary Testing
DAILY ROLES & RESPONSIBILITIES OF A BEAUMONT MEDICAL LABORATORY SCIENTIST
Blood Bank

- One of the country’s busiest Transfusion Medicine Laboratories
- Automated and fully computerized
- Major role of the MLS: Test and issue wide variety of blood and tissue products

Erin, Class of December 2009, issuing a unit of red cells
Blood Bank techs rotate among four major analytical benches:

- Triage
- Type & screen
- Antibody problems
- Crossmatch / Moms & Babies
Triage Responsibilities

- Issue blood products in coolers on ice when Nursing and operating room staff come to the Blood Bank to request products in person.
- Accept samples arriving via the tube system and spin them down for testing.
- Thaw fresh frozen plasma and cryoprecipitate needed for patient use.
- Receive and issue cadaver bone products for surgery as well as organs such as kidneys, livers, and corneas for transplantation purposes.

Heather, Class of 2010, preparing a massive transfusion cooler containing red cells, plasma, platelets, and cryoprecipitate at triage.
Type & Screen

- The MLS assigned to the type and screen bench is in charge of the physical testing of all patient samples.
- They perform ABO and Rh typing as well as antibody screening procedures on each sample.
- Depending on the urgency of the test results, samples can be run manually or on the instrumentation using gel technology.

Marc, Class of 2010, loading a specimen onto the Ortho Provue™ automated instrument that performs patient ABO and Rh typing.
Antibody Problems

- The most complex bench in the blood bank.
- Patient samples with a positive antibody screen will receive a thorough workup before blood products can be released.
- Some problems are simple single antibody specificities only needing a single panel and antigen typing performed, however many of our patients have been multiply transfused and require an extensive multi-panel work up.

Danelle, Class of 2000, training Zeinab, Class of June 2015, at the antibody problems bench
Crossmatch / Moms & Babies

- The MLS will crossmatch blood products for patients with orders for transfusion.
- Electronic, immediate spin, all-phase, and 60 minute no liss crossmatching are just some of the testing performed on this bench.
- The MLS on this bench are also in charge of reviewing the daily labor and delivery log to ensure all moms and babies have received the appropriate testing and that Rh negative mothers who have had Rh positive babies receive their Rhogam shots prior to being discharged from the hospital.

Sarah, Class of 2003, preparing a unit of crossmatch packed RBC’s for transfusion.
Additional Responsibilities

- All shifts begin with quality control (QC). Each shift has designated tasks to complete before patient work begins.
  - Day shift is responsible for making sure there are enough reagents in inventory, performing QC on select reagent racks, and taking temperatures of all equipment and refrigerators/freezers in the blood bank.
  - Afternoon shift is responsible for the ordering of blood products for the following day, in addition to taking temperatures of equipment, and running QC on reagent screening cells.
  - Midnight shift is responsible for all instrument maintenance, some of which is run daily, weekly, or monthly, and preparing reagent racks.

- In addition to the daily work at the benches, the Blood Bank MLS also takes part in daily rounds with the blood bank pathologist; is assigned annual competency assessments; takes part quality assurance reporting; attend weekly department staff meetings and attends educational seminars.

- The MLS is also in charge of running patient direct antiglobulin testing, hemoglobin S testing of units, antigen typing units, and working with our area reference laboratory and blood centers to find rare blood products.
Medical Laboratory Scientists perform blood & body fluid cell enumeration on computerized automation.

They also evaluate blood and body fluid cell morphology under the microscope to detect the presence of:

- Red cell, white cell and platelet disorders
- Infection
- Malignancy
Hematology analytical benches include:

- Automated blood cell analysis
- Morphology bench for peripheral blood and body fluid differential counting
- Bone marrow
- Body fluid analysis
- Special RBC tests

Jackie, Class of 2012, preparing body fluid specimens for analysis
Automated Blood Cell Analyzers

• The MLS runs QC on the analyzer and verifies all results are in control before starting the daily run.
• Their major responsibility on this bench is to evaluate patient results and determine if further action needs to be taken.
  ✓ For example, perhaps a clot is suspected, the smear needs to be reviewed, or a manual method needs to be performed to obtain valid results.

State-of-the-art Sysmex™ cell analyzers and automated slide makers
Automated Blood Cell Analyzers - cont.

The MLS also performs instrument maintenance such as cleaning, replacing parts, and recording status values on a maintenance sheet.

Michelle, Class of 2002, performing maintenance on Sysmex XE-5000 cell analyzer
Morphology Bench:

- The MLS evaluates blood and body fluid cell morphology under the microscope to detect the presence of anemia, leukemia, or lymphoma.
- They need to have a keen eye for differentiating details between normal and abnormal cells.
Bone Marrow Bench:

• The MLS assists the nurse practitioner or pathologist by making smears at the patient bedside.
• The MLS then process the biopsy specimen and stains the smears for review by the pathologists.

Natalie, Class of 2009, staining bone marrow aspirate smears for examination by the pathologist.
Additional Responsibilities:

✓ Interaction between technologists and pathologists is essential to the Hematology lab running smoothly. You may need to consult the pathologists when certain abnormalities are observed on smear reviews.

✓ Your skills as a technologist will be tested by yearly competency assessments that measure the ability of the technologist to perform daily tasks such as running controls and reporting patients.

✓ A CAP survey may be assigned to your bench on that day and you will be responsible to complete this survey. Surveys come in the form of prepared samples that are to be tested in the same manner as a real patient specimen.

✓ Technologist are in charge of inventory. They make sure there are enough supplies to get us through until the next order can be placed.
In this department, Medical Laboratory Scientists perform a complete range of routine and specialized tests for comprehensive evaluation of patients with inherited and acquired bleeding disorders, thromboembolic complications, hypercoagulable states, and disorders of platelet function.
Routine Coagulation Testing

- Routine testing is performed on the Sysmex™ CA-7000
- Tests include:
  - aPTT (Activated Partial Thromboplastin Time)
  - Protime INR
  - Thrombin Time (TT)
  - Fibrinogen
  - Inhibitor/Anticoagulant Screen
  - D-Dimer

Matt, Class of Dec, 2012, loading routine coagulation specimens onto the Sysmex™ CA-7000 analyzer
Specialized Coagulation Testing

The MLS is trained to perform over 20 specialized tests, each via its own analytical test methodology. They include:

- Platelet function & aggregation
- Special factor studies
- Fibrin Stabilizing Factor
- Factor Assays
- Von Willebrand Factor Antigen
- Antithrombin III
- Protein C Activity and Antigen
- Protein S Activity and Antigen
- Activated Protein C Resistance
- Risocetin Cofactor
- Reptilase Time
- Anti-Xa LMWH
- Heparin anti-Xa
- Dilute Russell Viper Venom Time (dRVVT)
Histocompatibility

Medical Laboratory Scientists perform typing of white blood cells for HLA antigens to determine:

- if a donor organ or bone marrow is a good match for transplantation into a recipient
- certain disease associations
Histocompatibility

- Historically, HLA typing has been done at the protein level using the microlymphocytoxicity test method.
- Today, HLA typing at the DNA level using PCR has become the method of choice for clinical laboratories.

Kathryn, Class of 1995, analyzing lymphocyte toxicity reactions
Flow Cytometry

The Flow Cytometry Laboratory uses sensitive multi-parametric flow cytometry methods to provide semi-quantitative analysis of blood, bone marrow, fresh tissue (e.g., lymph node) suspensions, and body fluids including CSF. Sensitivity of detection for most specimens has been validated to 0.1-0.5 percent.
Flow Cytometry

Medical Laboratory Scientists use the flow cytometer to detect:

- abnormal cell surface markers found in leukemia and lymphoma
- lymphocyte subsets in HIV infection
Typical day-to-day analysis includes:

- Document receipt of specimen
- Process specimen to isolate the cells
- Add monoclonal fluorescent antibodies to the cells and incubate
- Load the cell/antibody samples on the flow cytometer for optical measurement
- Analyze the resulting scatterplots
- Evaluate final test results
- Report results in the LIS

Jennifer processing a lymph node tissue under the biohazard hood

Brandy, Class of 2004, analyzing resulting scatterplots
Additional Responsibilities

Flow Cytometry techs are also responsible to:

✓ Evaluate Quality Control measures to determine reagent and instrumentation acceptability and troubleshoot any issues that arise in the process.

✓ Set up tests according to procedure that they run, evaluate and report out while using information from patient history and current presentation.

✓ Work closely with each other, supervisors, pathologists, residents and fellows to help determine proper patient care, troubleshooting issues and excellent customer service.
• State-of-the-art automation

• One of the largest laboratory departments, it receives:
  • 5 thousand specimen tubes a day
  • 1.8 million specimens a year
Chemistry Medical Laboratory Scientists and Technicians analyze blood serum for hundreds of biochemical elements that reflect cardiac, liver, renal, endocrine and acid/base function.

A typical day includes the responsibility to:
- Monitor instrument quality control data and function.
- Review and verify patient results, being sure all results correlate with previous results as well as the disease state of the patient.
Chemistry benches include:

• **Core Lab Line** (includes chemistry panels, immunoassay, electrolytes, and cardiac and liver markers)

• **STAT Lab**

• **Urinalysis**

• **Toxicology** (including therapeutic drug monitoring)
Chemistry Line Operators

- The automated lines include the following analyzers: Advia, Vista, Architect, and Centaur.

- Line operators set up the instruments each day before patient sample analysis begins.

  - The set-up includes any daily/weekly/monthly maintenance that is required, loading the proper amount of reagents for the daily workload, and running calibrations and quality controls (QC) on each instrument.
Chemistry Line Operators (cont.)

- Line operators then run patient samples during their shift including tests for electrolytes, liver enzymes, renal function testing, HIV, hormones and hepatitis, just to name a few.

- They are also responsible for troubleshooting any issues that arise on either the instruments or for patient samples.
  - Some examples of issues that can arise throughout the day are failed calibrations, failed QC, probe jams, instrument malfunctions, and patient specimen integrity issues that need to be addressed (hemolyzed, lipemic, clotted, quantity not sufficient, etc.).
STAT Testing Lab

- Separate laboratory in the hospital that provides testing services for EC, pre-OP, OR, and ICU patient care areas.

- Variety of instrumentation to perform “STAT” chemistry, blood gas, hematology, coagulation testing as well as manual qualitative serum/urine pregnancy tests and rapid HIV tests.
Medical Laboratory Scientists must recognize a critical value and call it to the appropriate patient unit nurse in charge.

The critical result must be repeated back by the nurse and is documented in the laboratory information system.

Some instruments are “interfaced” to the laboratory software permitting results within a normal range to be automatically reported out.
Additional Responsibilities

Chemistry technologists are also busy with:

- Daily instrument maintenance and quality control.

- Chemistry technologists are also responsible for running CAP Proficiency testing samples on all instruments and testing platforms to ensure our instruments are properly performing the testing and the technologists are following procedures. These are not performed daily on each instrument/test platform but they are run when required according to CAP.

- Special projects and statistical analysis for stability testing and other studies when needed.
Urinalysis - Chemical Analysis

• Medical Laboratory Scientists use automated analyzers and chemical dipstick methodology to test urine for pH, glucose, protein, ketones, bilirubin, and other constituents.

• When abnormal results are detected by the analyzer, the technologist will manually confirm those results by looking at a drop of centrifuged urine sediment under the microscope.

• The microscopic examination is done to identify elements such as white blood cells, red blood cells, epithelial cells, casts, crystals, yeast, and bacteria.
Urinalysis - Microscopic Analysis

Sara, Class of 2012, performing manual microscopic urine examination
Toxicology

- Medical Laboratory Scientists utilize an Architect immunoassay analyzer to measure concentrations of therapeutic drugs in urine and serum samples.

- In addition, they use sophisticated thin-layer chromatography or gas chromatography/mass spectrometry equipment to identify drugs of abuse.
Toxicology (cont.)

Kim, class of 1977, working on the Liquid Chromatography (LC) column
Immunology

- Performs testing for autoimmune diseases, in-vitro allergy testing, infectious disease serologies, protein quantitations, tumor markers, protein immunofixation, and some therapeutic drug monitoring.

- Provides a battery of assays to determine antibody and antigen responses to viral and bacterial infections for diagnosis of disease.
The Immunology MLS works in two separate laboratories to accommodate the wide variety of testing.

Routine benches include:

- Electrophoresis
- Immunofixation
- ELISA
- Radioimmunoassay
- Allergy and immune status testing
- Infectious diseases
- Hormone testing
Immunology (cont.)

Kelsey, Class of 2015, learning the use of an automated allergy testing instrument from Janell, Class of 2004
Microbiology

The Clinical Microbiology Laboratory provides a full spectrum of tests (ranging from traditional culture to state-of-the-art molecular methods) for the detection of medically important bacteria, fungi, parasites, and viruses in clinical specimens and provides information about the susceptibility of bacterial agents to select antibiotics.
Medical Laboratory Scientists use various culture techniques to determine which bacteria, virus or fungus might be causing illness. They also perform antimicrobial susceptibility testing on bacterial isolates to determine what antibiotics will be effective in treating the infection.

Latoya, Class of 2004, performing colony isolation for antibiotic susceptibility testing.
The Microbiology benches include:

**Routine cultures**
- Blood
- Respiratory
- Stool
- Wounds
- Urine
- Genitals

**Specialty benches**
- Anaerobes
- Parasitology
- Virology
- PCR
- MALDI-TOF
- Antibiotic susceptibility testing
Biosafety Level 3 (BSL-3) Laboratory

- Specially contained laboratory for:
  - Acid-fast bacilli testing and cultures
  - Fungal cultures

Kelsey, Class of 2015, preparing specimens for mycobacterial culture

Chris, Class of 2015, examining a direct smear for the presence of acid-fast bacilli
Opened in 1991, it was among the first national molecular pathology laboratories and is now recognized as a Molecular Center of Excellence.

This laboratory utilizes DNA-based technologies for its diagnostic assays.

In addition, Southern blot-based and polymerase chain reaction based assays are used in the diagnosis and prognosis of disease and monitoring of disease therapy.
Molecular Pathology

- Typical day-to-day analysis includes:
  - Document receipt of specimen
  - Extract DNA
  - Run amplified DNA via required analytical technique
  - Evaluate testing data
  - Report result in LIS

Extracted DNA

Amplifier
Molecular Pathology

The DNA nucleic acid sequences are then studied for:

- unique sequences of various bacterial, fungal or viral organisms
- defective genes found in inherited disease such as cystic fibrosis
- mutations in certain cancer cells

More specifically, major testing investigates hematological malignancies; infection by Chlamydia trachomatis, Neisseria gonorrhoeae, and hepatitis C virus; factor V deficiency; HIV; HSV; and thrombotic risk assessment.
Laboratory techniques include:
- Nucleic acid extraction
- Purification and processing
- Electrophoresis
- *In-vitro* nucleic amplification techniques
- End-point & real-time PCR

Multiple genotyping assays via:
- PCR, xTAG and Invader technologies
Left: Samantha, Class of 2010, operating an automated platform that runs sexually transmitted disease assays (HSV, Chlamydia, Gonorrhea and Trichomonas).

Right: Samantha operating the real-time polymerase chain reaction (PCR) oncology technology system for the detection of mutations in the KRAS, BRAF and EGFR genes in tumor samples.
Ancillary Testing

- Ancillary Testing technologists oversee instrumentation, training and supervision of POC testing to approximately 70 nursing units and 30 off-site testing areas.
- Some examples of POC testing include Glucose meter testing, Activated clotting times, Hemoglobin, blood gas testing, among many others.
  - The largest POC testing program is for glucose meter testing with over 250 meters throughout the hospital and off-site testing areas.
Another important job role of the Medical Laboratory Scientist is to assist in the training of new employees and students, as well as pathology residents and fellows.

Students (Steve, Chris, and Kirstin, Class of 2015), and new hire (Matt, Class of 2012), receiving Hematology morphology training from MTII instructor (Dana Snyder, Class of 2009).
CAREER REFLECTIONS
Career Reflections

“I chose the career of medical laboratory science because......

- I always liked math and science
- In high school I wanted to be an accountant but my science teacher talked to me about different health professions which changed my interest
- I did not want to be a doctor or nurse because of the patient contact, so I chose Medical Technology
- I like the idea of helping not only the physician but also the patient without having contact with them
- After working in all the areas of the lab, I decided I enjoyed Microbiology the best
- I am organized and detail oriented which is very useful in Microbiology.
- I like putting the “puzzle” together when the cultures are difficult to figure out.
- I like making decisions (based on procedures and experience) for cultures that require more than the “normal” workup.
- I find it interesting to learn something new every day especially with methods that detect resistant organisms.
- I also like the variety of work in Micro from bacterial cultures, parasites, mycobacteriology, mycology and virology.”

- Caroline Loomis, Microbiology Clinical Instructor
Career Reflections

“I chose this career because I really enjoyed my science curriculum in school but found patient contact was not for me. With the right guidance, I learned of Medical Laboratory Science and it’s very important role in the medical community. Although there are things about the career I dislike, I stay because of the new challenges that each day brings. I’m constantly learning and there is always opportunity to change to a different lab section which keep this career interesting. I also enjoy knowing that indirectly my coworkers and I save lives every day that may not be save if it weren’t for our commitment to excellence. This is truly a noble profession and a service that will always be needed.”

- Sara Wagner, Hematology Clinical Instructor, 2010 Graduate
“My favorite part of being a Medical Laboratory Scientist, and why I chose this career, is the fact that there is always something new to learn; a new instrument, a new test, or a new procedure pops up all the time in the laboratory! I also love that every day I am helping doctors and nurses care for our patients by providing accurate and reliable test results, even though we don’t often come in to face-to-face contact with our patients.”

- Brittnie Berger, former Clinical Chemistry/Immunology Instructor
Career Reflections

“I chose the career of Medical Laboratory Science because I enjoy the work environment and I enjoy not having to take work home with me. When I clock out, I am able to focus on my personal life. Another reason I have chosen to stay a Med Tech is because I make a good salary and have benefits like health insurance, access to retirement accounts and paid vacation time. The last reason I have chosen to stay a Med Tech is because I learn new things everyday regarding disease states, patients and instrumentation. Having a career that I continue to learn at makes me feel fulfilled.”

- Natalie Supert, Flow Cytometry Clinical Instructor, 2009 Graduate
Summary

• Beaumont Laboratory is among the highest test volume hospital-based laboratories in the country. This presentation highlighted the operations of the Beaumont-Royal Oak campus.

• Our Medical Laboratory Scientists are highly skilled, dedicated professionals who are vital members of the health care team. They typically specialize in one clinical laboratory discipline.

• We hope this presentation has provided a better understanding and appreciation of the day-to-day responsibilities of a Medical Laboratory Scientist.
Beaumont MLS Applicants:

- Please be prepared to discuss the following questions at your upcoming interview:
  - What new information about the role of a medical laboratory scientist did you learn from this presentation?
  - What clinical laboratory techniques you are learning in your university lab courses?
  - What is your definition of a medical laboratory professional?
Individuals Interested in Medical Laboratory Science:

- For others who have happened upon this presentation, please visit the Beaumont School of Medical Laboratory Science webpage for more information about the career.

www.beaumont.edu/alliedhealth > Medical Laboratory Science