

Clinical Laboratory Scientists at Work

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Vignettes of the profession of Clinical Laboratory Science

These dramatizations are designed to introduce you to the real life experiences that make up the working day of Clinical Laboratory Scientists, also called Medical Technologists. While the characters, both patients and scientists, are fictional, the situations are real.

Clinical Laboratory Scientists work in hospital laboratories, in industry, in research, and in physicians' offices and clinics.

They have developed academic and technical competence in the major areas of clinical laboratory practice—hematology, clinical microbiology, clinical chemistry and immunohematology.

Clinical Laboratory Science programs leading to the B.S. Degree are found in universities associated with medical centers.

Also, many colleges and universities have Clinical Laboratory Science curricula that operate in conjunction with hospital based Clinical Laboratory Science Programs.

In addition, two-year Clinical Laboratory Technology, also called Medical Laboratory Technology, programs, leading to the A.S. or A.A.S degree, are found in many community colleges.

Microbiology Laboratory Is it Meningitis? If so what kind?

When Susan walked into the laboratory all signs pointed to a routine evening. She walked through each section of the lab and checked with the clinical laboratory scientists in charge as they were finishing the day's work.

In Hematology she found everything finished for the time being.

In Clinical Chemistry she found that there were several timed blood sugars for her to collect and run later.

In the blood bank, she found a request to type blood on an expectant mother in labor and test it for antibodies, in case of difficulty during delivery.

Soon the daytime staff would be gone and she and one other clinical laboratory scientist, Donald, would have the laboratory to themselves until midnight.

She liked working evenings because she enjoyed working in all the departments. She liked the variety of tasks and the easy camaraderie that developed between the laboratory staff and staff in the emergency room and on the patient floors.

She was able to work in whatever department a test was needed. It was a challenge in many ways because it meant she had to keep up with current developments in techniques and equipment in all departments. The higher salary for evening hours was an added bonus.

Susan had collected one of the timed blood glucose tests and had just finished analyzing it when the telephone rang. It was the emergency room. They wanted her to come down and pick up some spinal fluid on a three-year old child for analysis.

As she pushed aside the curtain of the Emergency Room cubicle, the doctor was just finishing the spinal tap. The child, semi-conscious and burning with fever, was on her side and the doctor was holding a gauze pad on a spot on her

lower back. Her distraught parents were trying to stay out of the way of the doctor and nurse working over her, their eyes glued to their daughter's face.

"We'll need a cell count on this spinal fluid," the doctor said, "and a culture, glucose and protein. This looks like it may be meningitis."

Susan nodded. She took the three tubes of spinal fluid from the nurse carefully, noting with a sinking heart that she could detect a slight cloudiness in what should have been crystal clear fluid. Susan hurried back toward the lab, mentally prioritizing what she had to do.

She knew that what she needed to find out right away was whether there were white blood cells in the spinal fluid and if so what kind they were. If there were cells present in the normally clear, cell-free spinal fluid, then they were there to fight an infection. And chances were that the child had meningitis.

Of course the culture of the spinal fluid would tell that for sure but it would be many hours before the organisms that Susan planted on the culture medium and incubated at body temperature would grow and become identifiable. And from the looks of it, this child didn't have many hours. The doctor needed some solid information to go on now.

Perhaps she would even be lucky enough to see some organisms on a slide with the Gram stain. She could only hope and do her best.

Back in the laboratory, Susan gave one tube of spinal fluid to Donald to test for glucose and protein. Then she donned a fresh pair of protective gloves and went to work. She drew up some of the fluid in a sterile pipet, placed it carefully into the growth media and put it in the incubator.

She went to the hematology department, plated the fluid on a counting chamber and focused the microscope. She was not surprised to see a large number of white cells and began to count rapidly. The slide she made and stained

revealed them to be neutrophils, bacteria fighting cells. Not good.

She made a slide and did the Gram stain procedure. Then she sat down at the microscope to look for the bacteria themselves. If she could just see some organisms on this slide and get some clues to what they might be, she thought, as she scanned the slide. And then, there they were—gram negative diplococci, as big as life.

Neisseria meningitidis, she thought. It was an organism that could cause an often deadly meningitis. Just then Donald came in from the clinical chemistry section of the laboratory. "The glucose is below normal and the protein is above normal," he said. "That's it then," Susan said, gesturing for Donald to look in the microscope. "All the tests point to *Neisseria meningitidis*."

Susan punched the numbers into the phone and had the doctor paged. As she read the results in a calm, clear voice she could feel her body begin to relax. She had been hurrying so—the child's flushed, still face in the back of her mind, the frightened look on the parents' faces.

Now the doctor could start the antibiotics known to be best against *Neisseria*. She could tell him tomorrow after the culture had grown and the bacteria had been tested against various antibiotics whether he had made the very best choice.

But the doctor had to act now. If Susan hadn't been able to spot the gram negative bacteria he might have made a different decision about the antibiotic to use because so many organisms can cause meningitis.

As she stepped through the automatic double doors of the hospital into the cool night air and walked down the steps toward her car, she felt a calm satisfaction settling over her.

A night like tonight reminded her again that what she did mattered. She had chosen her profession well.

Immunoematology Laboratory

We have blood but is it right for *THIS* baby?

As Richard was finishing the afternoon inventory of the blood bank refrigerator in the hospital laboratory, he was thinking about the coming year and his plans to go back to school.

He had been accepted by the University Medical Center into the *Specialist in Blood Bank* postgraduate program. It would not be an easy year, financially or academically, but it had become increasingly clear to him in the three years since he finished his B.S. in Clinical Laboratory Science that it was something he wanted to do.

He had found his work in this small community hospital very rewarding and he enjoyed the friendliness of small town living. But he was ready for a new challenge and he had become fascinated by the amazing complexity of the human immune system. So much was being learned so fast and he wanted to be a part of it.

The telephone broke into his thoughts. It was a nurse in the labor and delivery room. A woman who had a history of problem pregnancies because of Rh antibodies had just been admitted.

She was in premature labor. The doctor was concerned that the baby would be born anemic and would need an immediate blood transfusion.

While the blood spun in the centrifuge, extracting the serum Richard would need for testing, he set out reagents and supplies. He would perform tests to detect and identify the antibodies in the mother's blood that were destroying the baby's red blood cells.

He then would need to find compatible blood for the baby that wouldn't be destroyed by the antibodies already circulating in the baby's blood stream.

No small task, especially if it turned out that more than one antibody was causing the trouble. Well, he probably had a

few hours, though you could never tell how fast a baby might come—especially since it wasn't the first. He had no time to waste.

He thought about the blood inventory. It was low. Not much to choose from. The Red Cross wouldn't be making another delivery until tomorrow.

As Richard studied the reactions between the reagents and the mother's blood serum he grew concerned. There was the anti-Rh antibody all right—but there was also another antibody. A single antibody would not cause this reaction pattern.

But what was it? He would have to do more testing. Working on this type of problem was Richard's favorite part of his job. He was solving a complicated puzzle based on his knowledge of blood group antigens and antibodies. It gave him a great deal of satisfaction. Tonight though, his desire to solve the puzzle was driven by a sense of urgency.

When Richard finally identified the additional antibody as anti-Jk^b, he was troubled. He tested his available units one after another and found them all incompatible.

He picked up the phone. He would have to explain the situation to the doctor and let her know there would be a delay. Next he would call the Red Cross Blood Center in the city. He could get the blood the baby needed but whether he could get it in fast enough was the question.

The Highway Patrol would agree to make an emergency delivery but it was still a two-hour drive at best. The mother's labor was progressing normally, the doctor said—there would probably be time, but Richard noted the slight edge of worry in her voice.

The local sheriff's deputy, who delivered the blood one hour and fifty minutes later, looked pleased with himself, but concerned. He had met the highway patrol at the county line as he usually did when blood had to be delivered in an emergency. But this time he had a special interest. The woman who had just delivered upstairs was his sister-in-law.

The deputy sat down in the waiting room while Richard did the cross-match that confirmed that the blood was compatible and safe for the new baby.

As Richard shook the deputy's hand and they clapped each other on the shoulder, he realized that he would miss this place when he left.

Histocompatibility Laboratory A Kidney for Ellie

When the telephone rang Mary Beth was in a deep sleep. She struggled to pull herself toward consciousness. "Oh no," she moaned groggily. "Not tonight. I'm too tired." She fumbled for the bedside lamp.

"Mary Beth," the familiar voice of the hospital's Donor Services Coordinator was wide-awake and matter of fact. "We've got a kidney coming in an hour. We need you down here."

"O.K." Mary Beth replied sleepily. She looked at the clock. It was 3:15. "I'll be right there."

The organ transplantation laboratory was dark and eerily quiet as Mary Beth began switching on lights, checking instruments and setting out supplies. Despite the cup of coffee she'd gulped down, she was finding it hard to shake off the lethargy of sleep.

Paula, the nurse coordinator for renal transplants, burst into the lab in such excitement that she banged the swinging door into the counter. She had a tube of blood in her hand.

"Oh Mary Beth," she exclaimed, "you won't believe it!"

"What?" Mary Beth asked wearily. Paula regularly worked the night shift and her cheerfulness was a little hard to take at this hour.

"It's Ellie," Paula said. "We've got a match for little Ellie."

Mary Beth stared. "For Ellie?" That can't be, she thought. "Do you mean it?" she asked, feeling the excitement growing within her.

"Yes," laughed Paula. "We've got a kidney with a 5 antigen match for little Ellie. That automatically bumped her to the top of the list!" She's being prepped for the O.R. right now! It's an unrelated donor from a car accident in New York state. The flight should be getting here in about 20 minutes." Mary Beth smiled. She felt like hugging Paula but suddenly she realized she didn't have time. She had to get to work. She opened the lab refrigerator and began setting out racks of reagents and supplies. "It makes you think that sometimes things do happen for the best, even when you think its terrible at the time," she said, still smiling.

Paula nodded, both of them thinking of that day two weeks ago. "Who would have thought—" Her voice trailed off.

Mary Beth took the tube of blood from Paula and turned to organize her work-station. "Buzz me when the kidney gets here," she said as Paula turned to leave. "And keep your fingers crossed," she added as the door closed.

The kidney came in a nondescript styrofoam cooler with cold packs around it. The snippet of lymph node Mary Beth needed for testing was in a tube alongside the kidney. She picked it up, made the proper I.D. checks and sent the courier on to the O.R., where everything was being readied for the transplant. The transplant team was just waiting for the word from Mary Beth that the cross-match was compatible.

Mary Beth thought back to the day two weeks ago when little Ellie and her mother were both waiting to go to the O.R. Everyone who knew Ellie couldn't help but love her. She was twelve but small for her age. She had spent a large part of her life in hospitals, yet she had a naturally sunny disposition and was cheerful most of the time. She made the staff her friends and there were many there that day two weeks ago who shed a tear as they shared her disappointment.

A kidney transplant was Ellie's only chance at having a normal life. She had been on the registry, waiting for a donor for a long time. She was undergoing dialysis more frequently but she was slowly getting weaker. Ellie's mother had decided that the only thing to do was give Ellie one of her kidneys, even though it probably would be rejected sooner or later. Maybe it would buy Ellie time until a better donor could be found. If there had been other children chances were good that one of them would have been a better match but Ellie was an only child. It was a desperate attempt that had reluctantly been agreed upon by the doctors and Ellie's dad. Still, everyone had been so hopeful once the decision was made.

Mother and daughter had both been tested extensively over the years. Ellie had no antibodies that would immediately begin to fight her mother's kidney. There was just that last cross-match that Mary Beth had to do before the operations were a "go." There was no reason to think that it would not be compatible.

Mary Beth had worked through the long and tedious cross-match procedure. She mixed Ellie's fresh blood serum with her mom's lymphocytes, white blood cells that have many of the same proteins as the kidney. She had incubated them together, stained the mixture and examined it under the microscope to see if all the mother's cells were still alive. Only dead cells would be stained. Live cells would exclude the dye.

Mary Beth had been so disheartened when she focused the microscope on all those stained dead cells. Somehow Ellie had developed an antibody to a protein on her mother's cells. Her mother's kidney would be rejected immediately. Perhaps Ellie had developed the antibody recently because of all the blood proteins she had been exposed to during dialysis. For whatever reason, the antibody was present and the transplant of her mother's kidney would not work. What a dejected little family group they were that day as they trudged to the parking lot to go back home!

That's why tonight was so wonderful. If Ellie had received her mother's kidney two weeks ago she would not be eligible for this one. And it was a 5 antigen match! A 6 antigen match was the best you could get and that usually came from a twin, sometimes from a sibling, but almost never from an unrelated donor. That meant it had a very good chance of never being rejected.

Mary Beth knew that this kidney, since it was obtained after accidental death, had been first tested for infectious diseases, then typed for red cell and white cell proteins. The results were then compared to the blood cell proteins of the many people who were waiting to receive a kidney. When the New York donor was entered into the computer registry, Ellie's name came up as a match.

Now Mary Beth's job was to isolate the lymphocytes from the donor, confirm that the tissue typing was correct and then to cross-match Ellie and the donor to be sure they were as compatible as they seemed.

Paula stuck her head in the door while the assay was in the incubation phase. "Just wanted you to know that the surgeons are scrubbing, the anesthesiologist is standing by and Ellie is prepped. They are just waiting for you to tell them that it's a go." She smiled. "How's that for pressure?"

"How's that for pressure, indeed?" thought Mary Beth. "Tell them it will be just a little while," she said.

Carefully Mary Beth placed the small tray of wells on the microscope. She focused on the mixture in the first well and began to study it. The stained dead cells would look orange. The live cells would be green. A compatible cross-match would have no more than ten percent dead cells. Slowly and methodically she moved the microscope from well to well and recorded the results of each examination.

Slowly she let out her breath. The cross-match was compatible!

She filled out the report and signed her name, then picked up the phone and dialed the renal transplant

coordinator's office. "Tell the surgeons it's a go", she said. She heard Paula's whoop before she hung up the phone.

After finishing all the paperwork, Mary Beth headed for the cafeteria for some breakfast. She let out a deep breath. Suddenly she felt very hungry.

"There are not many things worth getting up at 3 o'clock in the morning for," she thought, with a satisfied glow, "but this is one of them."

Hematology Laboratory Clues from the Cells

The University Health Service waiting room was crowded. There was already a line at the receptionist's window and there were the usual background sounds of sniffing, nose blowing and coughing coming from the waiting room.

Sandra readied her phlebotomy tray and called her first patient for blood testing. The young woman who walked slowly in was pale, more so perhaps because she hadn't put on any makeup. She was wearing rumpled sweats and she slumped tiredly into the chair that Sandra indicated. She commented grumpily that she was sick and tired of being sick and tired, and that now her throat was sore.

As Sandra drew the complete blood count and the mono test the physician had requested, she made an inward guess that this young woman would turn out to have the large reactive lymphocytes and positive serological test that were diagnostic of infectious mononucleosis.

Sandra watched the histograms on the computer screen of the automated cell counter in the hematology section of the small Student Health Center laboratory as she ran each blood sample. She would need to examine microscopically all the blood in which the instrument reported cells that did not fit its programmed parameters for normal cells.

She was not surprised that the blood of the young woman who was suspected of having infectious

mononucleosis was among those she must manually stain and examine.

The white blood cell count was quite high and the lymphocytic white cells she saw under the microscope were not the usual small compact lymphocytes of the healthy person. They were large, irregularly shaped and darkly stained—"stimulated" or "reactive" lymphocytes geared up to mount an immune response against an invader. That invader was probably the virus responsible for infectious mononucleosis.

"Probably", Sandra thought, "but not necessarily," She would have to look carefully. She knew that these large "stimulated" cells often seen in the relatively mild disorder, infectious mononucleosis, were very similar to the cells seen in lymphoid leukemia, a very serious condition indeed. Fatigue, swollen lymph nodes, a sore throat could all be symptoms of lymphoid leukemia as well as infectious mononucleosis. She would need to examine each cell carefully. Additional testing might be needed. "Let me know the results of this mono test when it's finished," Susan said to Allison, her co-worker, handing her a slip of paper. "I'm a little concerned about some of her white cells." "Oh, it's finished now," Allison replied. "It's positive." Sandra was relieved. Since the mono test detects certain antibodies found in infectious mononucleosis a positive result meant that the student indeed had infectious mononucleosis. That would account for all those abnormal lymphocytes.

At least now the young woman would know why she felt so sick and tired and would probably be quite relieved to know that it wasn't something worse. She would be told that plenty of rest, good food and time were her best allies in helping her body recover from this fairly common illness.

Clinical Chemistry Laboratory Is it a Heart Attack or a Routine Case of Flu?

Each morning Mark set up his automated chemistry analyzer with reagents and blood serum from patients and programmed in the tests that he would perform. He ran calibration and quality control checks and satisfied himself that the test results would be accurate. Later, he would look over the test printouts for abnormal results that might need to be telephoned to the physician.

But this morning was different because this was Mark's week to draw blood specimens from patients in the hospital's Urgent Care Center. This was a part of his job that Mark especially looked forward to. The Urgent Care Center had been set up to relieve the Emergency Room of the kind of problems that needed prompt attention but were not of a nature that required all the expensive resources of the Emergency Room. The patients who came in to the Urgent Care Center were mainly suffering from gastrointestinal upsets, fever and sore throats, bladder infections, strains and sprains. Mark enjoyed chatting with the patients as he drew their blood, doing what he could to calm their fears. He liked to think of himself as a good-will ambassador for the hospital laboratory. When patients referred to him as doctor he always took the opportunity to explain that he was a clinical laboratory scientist and that he tested their blood for many different components. He told them how the information he provided would guide their physician's diagnosis and treatment decisions.

Mark's first patient was a literature professor in her early fifties who taught in the nearby college. She had stopped by on her way to campus because, as she said, she felt like she was coming down with flu and if she had something catching she didn't want to expose her students. It had started in the night, she said. Her shoulders and neck muscles ached and her throat felt like it was closing up and she was having

trouble getting her breath. "Did the nurse swab your throat so the lab could do a culture?" Mark asked. "Yes," she answered, "and she assured me that it wasn't closing up and said it didn't even look very red." She was very pale. "I am feeling very queasy at the moment too," she said, indicating the emesis basin in her lap. Mark nodded sympathetically as he drew her blood. "We'll find out what the problem is," he said. Her skin felt cold and clammy and he saw beads of sweat on her forehead. He noticed that the physician had requested a series of cardiac marker enzymes as well as the more routine chemistries and complete blood count. "This may be more than a sore throat or flu," he thought.

The physician drew back the curtain around the cubicle. "Oh, hello Mark." She paused. "Could we have the Troponin T and CK-MB tests STAT please?" she asked. "Of course," replied Mark. "I'll call you with the results right away." He disposed of the needle and labeled the tubes. As he left, he heard the physician tell the patient that just as a precaution she had ordered an EKG. The patient replied that she most definitely was not having a heart attack and she didn't see the point in an EKG. She said it was that long hill behind the hospital that had made her heart beat fast and her blood pressure go up. "Besides," Mark heard her exclaim as he got on the elevator, "my chest is not hurting at all. It's my neck and shoulders!"

"These cardiac markers are STAT," Mark said as he turned the blood sample over to one of his colleagues in the lab. "The physician would like you to call the results down to Urgent Care as soon as they are ready." He turned to leave. "I've got another patient to draw but I'll be really interested to see the results of the cardiac markers on this patient. She is not having chest pain. She thinks she may be getting the flu. She is having neck and shoulder pain. She is nauseated and has broken out in a cold sweat. But she also has tachycardia and her blood pressure is up. I won't be surprised at all if she has had a myocardial infarction." His colleague looked up from

the chemistry analyzer with interest. "I'll let you know," she said.

As Mark headed back down the corridor toward the Urgent Care Center he thought about the recent advances in diagnosing heart attacks. The newer tests detect enzymes that are released into the blood stream when heart muscle is destroyed. The test for the enzyme CK-MB had been used for years and is good, no doubt about it, but the newer tests for the cardiac enzymes Troponin T and Troponin I were much more specific. The three tests together were almost a sure indicator of whether or not a heart attack had occurred. They were invaluable in a case like this where the symptoms were not the typical "two-ton-weight on chest" and shortness of breath syndrome that most males exhibited. Mark knew that many heart attacks in women went undiagnosed or were diagnosed too late for the women to get full benefit from treatment.

When Mark returned to the lab he found a note. "Both the Troponin T and the CK-MB were elevated" it said. "So it wasn't the flu after all," Mark thought.

"She is going to be very surprised to find out she has had a heart attack." But at least, he reasoned, she would now have a chance to have early treatment. The cardiologist might decide on "clot buster" drugs, angioplasty, bypass surgery or other treatment that was appropriate in her particular case.

Once again, Mark felt happy with the profession he had chosen. Clinical Laboratory Science continued to be just as interesting today as when he started into the B.S. program at his state university. You never stopped growing and learning because the boundaries of knowledge in the field of laboratory medicine kept advancing.

For more information about the profession of Clinical Laboratory Science and the educational requirements or to order additional copies of this booklet contact:

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