Jennifer Boland’s path to pathology began during her second year of medical school at Washington University in St. Louis. Boland would take study breaks by looking at specimen slides and images, learning to identify them. “Pathology is a visual science. I found it more enjoyable than memorizing notes,” she recalls. After a surgical pathology elective during her clinical rotations, she was hooked.

“In medicine it can be hard to find the field you love,” says Boland, who is now a pathologist at Mayo Clinic. “I was lucky enough to find it.”

Boland began practicing at Mayo three years ago, after completing a pathology residency as well as pulmonary and surgical pathology fellowships there. She specializes in pulmonary and bone and soft-tissue pathology. Her particular expertise is in lung and chest sarcomas. “They’re a rare and interesting set of tumors,” she says. “Very few are diagnosed in this country each year.”

Like many Mayo pathologists, she spends about half her time evaluating specimens from around the world for Mayo Medical Laboratories and the other half evaluating specimens from Mayo patients. Depending on case complexity, she evaluates around 25 to 50 specimens each day. “I like the mystery-solving of pathology,” she says.

Boland is one of 332 pathologists who practice in Minnesota, according to the Minnesota Board of Medical Practice.

Often thought of as either white-coated geeks hunched over microscopes or sexy swashbucklers who spend more time solving crimes than analyzing specimens (thanks to TV), pathologists...
are sleuths working behind the scenes to diagnose both the common and the uncommon.

“Every case is a question—What is it? And what are the questions I must ask myself to arrive at the correct diagnosis?” Boland says. “We’re in the unique position of combining what we learn in the lab with what’s learned in the clinic and in radiology to arrive at a diagnosis. Pathology is really a foundation of medicine.”

An underexposed field
Pathology isn’t an area medical students get much exposure to during clinical rotations. Although most medical schools require a classroom-based pathology course, medical students need to go out of their way to get clinical practice in pathology, Boland says, adding that many don’t because they went into medicine to treat people, not to work in a laboratory.

The field has two major branches—anatomic and clinical. Anatomic pathology is further divided into forensic pathology, cytopathology and surgical pathology. Clinical pathologists evaluate lymph, blood and urine. They also do toxicology studies, infectious disease tests, and blood banking and transfusion.

Pathologists complete a three-year residency if they want to become board-certified in either anatomic pathology or clinical pathology. They do a four-year residency if they want to be double-boarded, which many are. Many pathologists also complete one or more subspecialty fellowships, which usually take one year (two years for neuropathology). Forensic pathology, for example, requires a four-year residency plus a one-year fellowship.

The American Board of Pathology issues board certifications in anatomic and clinical pathology and subspecialty certifications in blood banking/transfusion medicine, chemical pathology, clinical informatics, cytopathology, hematology, dermatopathology, forensic pathology, medical microbiology, neuropathology, pediatric pathology and molecular genetic pathology. Nonboarded subspecialties in anatomic pathology include pulmonary, gastrointestinal, gynecologic, genitourinary, cardiac, bone and soft tissue, head and neck, infectious disease and general surgical.

Two years ago, Gary Keeney, M.D., an anatomic pathology consultant for Mayo Medical Laboratories, identified an immature teratoma in the thyroid gland of a pediatric patient. These usually occur in the ovaries. “I didn’t even know they could occur as a primary tumor in a thyroid,” he says. “This was a once-in-a-lifetime case.”

Then three months later, he saw another one just like it. “The more curve balls you see, the better you get at hitting them,” he says of such rare cases.

At Mayo Medical Laboratories (MML), which evaluates 20 million specimens a year from all over the world, the rare isn’t rare. “Things other labs may see once in a lifetime we see over and over,” says Keeney, who also chairs Mayo’s anatomic pathology department.

Mayo Clinic established MML in 1971 to provide pathology services to Rochester-area hospitals and clinics. Today, it provides services to 4,000 medical centers in 64 countries as well, performing 20 million tests each year at 64 subspecialty laboratories housed on the Mayo campus.

Most clients use MML for esoteric tests or tests for which they don’t have the equipment or expertise or that aren’t economical for them to perform. “They send us the testing that can’t be done at a community medical center laboratory,” says Andrew Tofilon, MML’s marketing administrator. Examples include next-generation sequencing for hereditary conditions, identifying viral DNA signatures and detecting molecular markers for rapid diagnosis of cancers and infections. MML also provides pathology consults and microbiology testing.

Mayo’s is the only pathology lab in the country that has a freezing microtome. This instrument freezes tissue faster and at a colder temperature than a cryostat. “It allows us to get reliable sections on tissues that are very difficult to section with a cryostat,” Keeney says. “One example is fatty breast tissue. Our breast tissue margins are analyzed while the patient is still on the operating table.”

According to Keeney’s analysis, Mayo Clinic returns 2 percent of breast lumpectomy patients for a second surgery for positive margins. The national average is 18 percent. “Freezing microtome is expensive and labor-intensive,” he says. “But in the end, you’re saving money—and it’s better for the patient.” —H.B.
In Minnesota, Mayo Clinic and the University of Minnesota have residency and fellowship programs. The University of Minnesota currently has 17 pathology residents and 12 fellows. Mayo has 20 residents and 20 fellows.

**When tissue is the issue**

Most pathologists who practice either clinical or anatomic pathology work in large academic health centers or large group practices where there is greater opportunity to specialize. Pathologists at community hospitals, clinics and small group practices are more likely to generalize and practice both. Most forensic pathologists work as medical examiners.

Mayo Clinic, home to the largest clinical lab in the state, Mayo Medical Laboratories, employs anatomic and clinical pathologists who can handle a wide range of cases (see “Laboratory for the World”). Most subspecialize in a specific area, for example, bone and soft tissue, endocrine, lung, neuro-oncology or skin cancer.

As director of the University of Minnesota’s anatomic pathology department, Jon Ritter, M.D., evaluates 20 to 30 specimens a day. He works with seven other anatomic pathologists who primarily evaluate biopsies and resections and take turns doing autopsies, as well as about 20 clinical pathologists who work in clinical chemistry, hematology, microbiology, blood bank, cytogenetics and molecular pathology.

He says he feels especially good when he can prevent unneeded treatment. That recently happened with a laryngeal biopsy that was initially thought to be a high-grade tumor but turned out to be benign. “We had the patient all queued up for surgery or chemotherapy because everyone was convinced there was malignancy, but there wasn’t,” he says.

In another such case, a woman thought to have a lung tumor and told she had one year to live turned out to have benign inflammatory changes in her lung. “Five years later,” Ritter says, “she was playing 18 holes of golf and carrying her bag.”

Sometimes, he says, clinical findings alone aren’t enough to determine cause of death, which is why it took an autopsy to determine why a deceased young man had unusual infiltrates in his lungs. “He’d injected ground up oxycontin that obstructed the vessels in his lungs. Sometimes there’s no substitute for putting organs in hand and having a look.”

Steven Eastep, M.D., an anatomic and clinical pathologist and medical director for St. Luke’s Hospital and Clinics in Duluth, most appreciates the service aspect of what he does. “I like working in the background providing the crucial information clinicians need to properly care for their patients.” He says that in addition to the truly unusual cases, the ones he remembers most are the ones where his diagnosis made a difference in a patient’s life and outcome. “We make life-changing decisions that determine whether a patient gets radical surgery, chemotherapy or radiation therapy.”

Sometimes those decisions are straightforward, but just as often, they’re complicated. “You put yourself through various mental gymnastics,” he says. When he or his three partners encounter a difficult case, they often gather around a multi-headed microscope. “Pathology is a process of internal and external peer review and continuing education,” he explains.

Eastep says one of the most important principles in practicing pathology is to make sure your diagnosis fits with what’s going on with the patient clinically. For example, grading lymphomas is often difficult and the criteria are not perfect. “When you are making decisions about the type and grade of a lymphoma, it’s vital to know if the patient has bulky disease and constitutional symptoms or is asymptomatic,” he says. Eastep recalls how during his fellowship, one of his mentors at Stanford University wouldn’t look at a consult case until he had all the relevant clinical information about the patient along with the slides.

He tells referring physicians to share what they know about the patient and their differential diagnosis with him and his team. “A lot of clinicians think telling us what they know about the patient biases our opinion. Nothing could be further from the truth. ... Clinical information is vital to helping us rule things out, narrow things down and make the best possible diagnosis.”
For example, knowing whether soft tissue from a biopsy is superficial or deep is critical. If the tumor is superficial, it may be atypical fibroxanthoma, which is likely to be benign. If it is deep, it may be malignant fibrous histiocytoma. The two look the same under the microscope. “The same is true with an atypical fatty tumor. If it’s present in the retro-peritoneum, it can eventually kill you. If it’s superficial, it’s predicted to be benign,” Eastep says.

A changing profession

Since starting his career 25 years ago, Stephen Bologna, M.D., one of seven pathologists at St. Cloud Pathologists, an independent group that primarily serves CentraCare’s clinics and hospital, has watched his field go through considerable changes.

One was the move to the electronic medical record. At first, he says, “the EMR was of little help and was a fairly huge nuisance.” Now, he considers it invaluable. He says they often use it to look up results from an earlier biopsy to compare with the current material they are viewing (often a larger surgical specimen).

Advances in molecular testing technology have enabled more precise identification of tumor types and bacterial organisms. Improved immunohistochemical staining techniques help distinguish between tumors that appear histologically similar; they also can be used to direct treatment. “As drugs become more targeted, our analysis must become more targeted in order to determine whether a particular drug will be effective for a patient,” Bologna says.

One negative change has been the growing number of checklists and the coding requirements necessary to complete a pathology report. “Checklists have had a positive effect on quality,” he says, “but they’re growing increasingly long and at times are burdensome.” Coding requirements are about to become more complex with ICD-10, as it will require even more specificity.

Another change has been the hit to compensation. Pathologists were once among the highest paid specialties, according to Ritter. Changes in billing practices in the 1970s and the start of diagnostic-related groups (DRGs) in the early 1980s reduced their compensation (they did so for other specialties as well). Today, pathologists in the United States earn on average $239,000, according to Medscape’s 2013 compensation report.

Ritter says uncertainty over compensation and the role of pathologists in the world of accountable care organizations may have contributed to a recent decrease in applications to pathology residency programs.

A needed field in need

Ritter notes that as labs offer increasingly sophisticated tests, primary care physicians will need to rely on pathologists more than ever to treat patients appropriately. In addition, many of the quality measures for health care outcomes are based partially or entirely on laboratory diagnostic testing. But a report on the state of the pathologist workforce in the United States published in the December 2013 Archives of Pathology Lab Medicine projects a shortage in the near future. As of 2010, there were approximately 18,000 practicing pathologists in the United States (5.7 per 100,000 population). The authors of the study projected that only 14,000 full-time pathologists (3.7 per 100,000) will be practicing by 2030, even though 20,000 will be needed. They also noted that starting in 2015, the number of pathologists retiring will increase precipitously, and they argue that the Council on Graduate Medical Education needs to make pathology a high-priority specialty by increasing the number of residency positions as well as funding for those positions.

“Pathologists drive medicine’s engine to do the right thing at the right time by providing a complete, accurate diagnosis that helps determine the right treatment and even if treatment is necessary,” Ritter says. “People get sick. Lab testing helps make the diagnosis, and we’re the people who know how to do that.” MM

Howard Bell is a medical writer and frequent contributor to Minnesota Medicine.
MY MOST MEMORABLE CASES

Stephen Bologna, M.D.

Although Stephen Bologna, M.D., has been a pathologist for 25 years, he still sees surprising, unusual, even confounding cases daily. As one of seven pathologists at St. Cloud Pathologists, he says tumors, especially brain tumors and lymphomas, can be difficult to diagnose. So can unusual fungal infections that may mimic tumors. “Most pathologists come out of training with a pretty good-sized ego that quickly shrinks,” he says. “You can’t get a fat head in our work.”

Bologna recalls a couple of once-in-a-lifetime cases—one of choriocarcinoma, a rare quick-growing uterine cancer that usually develops during or shortly after pregnancy; and another involving a type of mastocytosis more commonly found in dogs.

Another one that challenged the pathologists at St. Cloud Hospital involved two dozen patients who developed unexplained septicemia with fever, chills and shaking while recovering from surgery. Ochrobactrum anthropi, a bacteria commonly found in the environment, was found in the patients’ bloodstreams. Staff checked every possible source for the bacteria, but found nothing.

They consulted with experts from the CDC who suggested the possibility of drug diversion. It turned out that all of the patients who tested positive for the organism had received IV hydromorphone. Unopened IV bags were found to be sterile. Bags that had been used were contaminated. A surgical unit nurse eventually admitted to siphoning hydromorphone from IV bags and injecting contaminated saline into them to make it appear nothing had been removed.

Steven Eastep, M.D.

When Steven Eastep, M.D., was a surgical pathology fellow at Stanford University 20 years ago, his mentor, Ronald Dorfman, M.D., told him he would rarely see Hodgkins lymphoma during his career. That hasn’t been the case. Eastep, who works at St. Luke’s Hospital in Duluth, says he’s diagnosed most of the variants of this lymphoma many times. “We see rare cases all the time,” he explains.

Eastep recalls a case of follicular dendritic cell sarcoma, a rare lymph node tumor that he’s seen only once since his fellowship. And he’s identified two cases of rare sinus histiocytosis with massive lymphadenopathy, otherwise known as Rosai-Dorfman disease, named after his mentor and Juan Rosai, M.D., former head of the University of Minnesota surgical pathology department. One of those cases included extranodal skin presentation, which Eastep says “is a rarity within a rarity.”

Jon Ritter, M.D.

Jon Ritter, M.D., director of the University of Minnesota’s anatomical pathology department, recalls his most unusual case. It involved an older patient who’d had a thymoma removed and four years later developed lung infiltrates that Ritter and his colleagues determined to be a benign inflammatory condition.

“The surgeon didn’t believe us and took out the right lower lobe of the lung, which I examined and determined there was Pneumocystis pneumonia, which generally occurs in patients with AIDS or some other immunodeficiency. The infectious disease team came by and told me I was crazy because his HIV test was negative, and he wasn’t on immunosuppressants.”

Ritter suggested it was Good syndrome, an immunodeficiency in patients with thymoma or who have had thymoma. Additional testing showed a CD4 count that was almost zero, which confirmed Ritter’s diagnosis.

Jennifer Boland, M.D.

A case doesn’t have to be exotic to be memorable. Mayo Clinic’s Jennifer Boland, M.D., recalls two such instances when she diagnosed an invasive fungal infection based on frozen section examination of tissue. Both patients were being treated for lymphoma and, therefore, had suppressed immune systems.

One patient had a facial/orbital lesion that was thought to be related to the lymphoma. The other had a segment of bowel resected, which was thought to be ischemic from vascular insufficiency.

“Invasive fungal infections typically occur in patients with suppressed immune systems,” she says. “They’re hard to treat, progress rapidly, and are often deadly—so time is of the essence.”

Frozen section evaluation allowed both patients to start therapy at least a day earlier than would have been possible if such analysis had not been available. “What’s memorable is the ’jaw drop’ reaction you get when you deliver an unexpected diagnosis and you know you’ve made an immediate and positive impact on patient care.”

Angelique Quinn Strobl, M.D.

A case that is memorable to forensic pathologist Angelique Quinn Strobl is one that occurred early in her career. A young man contacted her office to review the autopsy report on his brother, who died unexpectedly in his 20s while on a family vacation. The autopsy revealed no cause for his death.

“I reviewed the findings and could find little that the original pathologist did not,” she says. So she referred the man to a genetic arrhythmia center. A year later, he called Strobl to tell her that the center found a genetic mutation that predisposes him to a lethal cardiac arrhythmia—likely what killed his brother. “He had a defibrillator placed, and he became my one life saved.”