

MASSACHUSETTS GENERAL HOSPITAL

The FedEx of Pathology Labs

Introduction

Massachusetts General Hospital (MGH) is the oldest and largest hospital in New England. The hospital has more than 893 beds, admits approximately 44,000 inpatients and handles more than 1.5 million outpatient visits each year in its extensive outpatient programs at the main campus and at its four health centers: Back Bay, Charlestown, Chelsea and Revere. In addition, as a teaching facility of Harvard University and a partner of Shriners's Hospital, MGH's pathology laboratory processes roughly 400,000 specimens each year. MGH conducts the largest hospital-based research program in the United States, with an annual research budget of more than \$400 million. In July 2004, MGH was named one of the country's best hospitals by *U.S. News and World Report* for the 15th year, ranking third nationwide.



Massachusetts General Hospital

Underneath the streets of Boston is the foundation of Massachusetts General, the third-oldest general hospital in the United States. The hospital's narrow, winding tunnels lined with steam pipes and bordered by stone walls remind visitors and the bustling staff of the hospital's 19th-century origin. Hospital employees and white-coated medical personnel darting from room-to-room are oblivious now to the black-and-white photos of medical milestones that decorate the walls of the historic place of healing. The yellow-tinted hallways provide ample light to study the famous photos of the first pain-free surgery performed using ether as an anesthetic; the doctor who first recognized the true nature of appendicitis; and the physician who made the first X-ray image in the United States. Massachusetts General Hospital has always been a place for firsts, and today, it continues to be at the forefront of medical technology innovation.

MGH's Pathology Lab Faces A Challenge

Lab directors merely shake their heads when considering the possible error points along the more than dozen stops a human specimen takes before finally arriving at the pathologist for a diagnosis. They understand that behind the 8-15 digit accession number are real people waiting for the results of the lab procedures of grossing, tissue processing, embedding, cutting, staining, coverslipping and analysis to finally learn what the future holds for them. Unfortunately, lab directors at the majority of labs across the country are working with outdated, non-integrated computer systems, hand-written instructions, multiple points of visual verification and inconsistent workflow accountability.

Short on budget, but deep in responsibility, pathology labs face mounting pressures to reduce errors and improve workflow efficiencies. A single keying error, mislabeled slide or misidentified sample at any point in the process can delay a diagnosis or force technicians to repeat tests or redraw samples. As a result, lab directors have been looking for workflow automation solutions that can survive in a laboratory environment. Fortunately, innovations in bar code labeling and tracking systems are making it easier for labs to harness the power of bar coding identification and tracking technologies.

Multiple Points of Potential Misidentification Errors Exist

Every day in pathology labs across the United States, technicians juggle dozens of requisitions and containers with specimens that are often identified with handwritten instructions, patient information and several long numbers. In a typical histology lab, for example, blocks are cut from a specimen to be processed. Depending on the size of the specimen, there may be several cassettes requiring several block numbers. The typical accession number is 5 or 6 characters plus a prefix of a facility in two or three digits, and a date code in two. This gives the accession number the possibility of up to 11 characters. As block numbers can be up to 4 characters, a total of 15 characters may have to be inputted into the system at the grossing station. Technicians can be responsible for dozens of cassettes with specimens awaiting their turn to be embedded in hot paraffin, cut on the microtome, stained and diagnosed. Depending on the size of the patient tissue, the embedding technician may be working with several cassettes, several block numbers and several jars.

At more than a dozen points along the process, each of the accession and block numbers needs to be verified and tracked. In many labs, this verification and tracking is done both visually and manually. In addition to manually inputting the accession number at least twice at the grossing station, technicians are also forced to type each accession number into a separate computer to print corresponding slides.

Cassettes often have handwritten numbers and associated slides will have a standard label with numbers written with a pencil, pen or a Sharpie.

Due to the harsh conditions present in the preparation of slides, including complex stains and reagents such as xylene, hematoxylin, eosin and feulgen, traditional slide labels are inadequate. As a result, many labs have reverted



Technicians must verify slide identification at many different points along the process, from grossing to checkout to archiving.



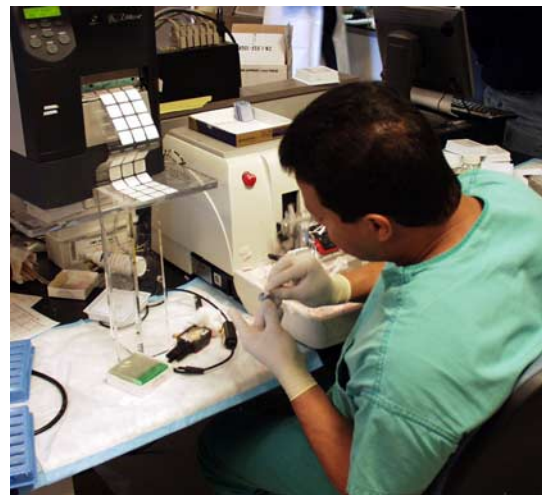
Tissue and specimen slides are subjected to a protocol of harsh chemicals and stains in the lab's staining process.

to hand writing the accession number on a slide and labeling specimen slides only after the staining process has been completed. This method of identification, which is traditionally a hand-written note on a piece of tape or a standard label, can result in a variety of errors and delayed diagnoses, thereby hampering efforts to provide quality patient care.

When you combine a rotating staff, dozens of cassettes and slides, long, 8-15 digit accession numbers, and chemicals and stains, one can begin to understand how identification and tracking errors can occur. The complexity of the lab's workflow, the difficulties of integrating different hardware and software applications, and the absence of a cost-effective labeling system that can survive the rigors of the lab's staining protocol have all prevented the development of an efficient specimen tracking system. Fortunately, progressive health institutions such as MGH have taken the lead by implementing bar code technology; replacing handwritten notes and numbers with data-rich bar codes on durable, lab-tested labels, and exchanging visual verification for laser scanners and work-flow accountability tracking.

MGH Adopts a Bar Code-Based Tracking System

On the third floor of MGH's Blake building, a white-gloved lab technician pulls a specimen cassette from an ice-filled tin pan. As it is passed under the bar code scanner mounted to his workstation, the direct thermal printer is instructed to print out an exact number of StainerShield labels with corresponding accession, block and cut numbers in a 128 Series C bar code. The technician places the cassette delicately on a microtome machine. The machine glides up and down over a thin blade, cutting the paraffin-embedded specimen into a microscopic ribbon. Using a small dowel, the technician places this thin sample into a cooling bath where he examines it and places it on a glass slide already labeled with the StainerShield bar code label. The technician repeats the process several more times before an entire tray of slides is ready to go into a pre-programmed staining machine.



MGH pathology lab technician applies a barcoded StainerShield label to a slide at a cutting station.

This labeling process seems simple enough, yet the process itself is part of an innovative tracking system that is once again placing Massachusetts General Hospital at the forefront of medical technology. In a few short months, MGH has become an industry leader for using bar code technology to improve lab processes and enhance patient safety. The hospital's focus on implementing bar code technology has positioned its pathology labs ahead of any

current standards and regulations, and has eliminated errors that, in other hospitals, routinely inhibit quality patient care and lead to improper diagnoses of patient ailments.

Before implementing bar codes, MGH's pathology lab was like many other labs in the country; using standard labels, hand-written numbering and visual verification. When introduced to MGH's pathology lab directors, John Zimmermann, a bar code data collection systems and labeling solutions consultant with Schoffer & Co., found a lab in transition. "MGH was actively looking for printers and scanners to update the tracking process in its labs. Lab technicians used paper-based labels, and were experiencing between 3-5 change block orders a day due to improperly identified or mislabeled slides," Zimmermann said. "Like many labs today, there are a lot of machines that don't work together, and technicians spend too much time and take too many risks because of the ineffective labeling process. MGH worked through the workflow complexities and integration issues to develop a state-of-the-art tracking system that has caught the eye of other labs across the country."

Under the direction of Dr. Ulysses J. Balis, director of pathology informatics and assistant professor of pathology at Harvard Medical School and Massachusetts General Hospital, MGH has developed a just-in-time identification and tracking method. The lab uses bar code technology to help eliminate identification errors and provide better specimen tracking from the time they are received in the lab all the way through checkout. At several points along the way, bar codes on the cassettes and slides are scanned, uploading data into the laboratory's information system (LIS) and providing the labs with a complete workflow history, including time-stamping and accountability. The tracking system helps technicians to group slides and track specimens, while eliminating the need to manually key-in accession numbers.



Slides containing stained and coverslipped specimens are prepared for checkout from the lab. Barcodes on the slides are scanned to check them out of the lab and confirm the right slide is going to the right resident for study and analysis.

MGH Uses StainerShield to Bar Code Label Slides Pre-Stainer

A crucial part of the tracking system is StainerShield, the durable, bar coded slide label that has proven that it can withstand the harsh lab procedures which expose specimens to a variety of temperatures and chemicals, including xylene and alcohol, as well as a complex staining process. StainerShield, a patent-pending technology developed by General Data Company, was integrated into the process to allow technicians to print on-demand slide labels at the cutting stations. These labels contain patient and case-specific data in both bar code and human-readable format, and are applied to the slides at the cutting station, before the slides go through the stainer. Printing on-demand bar coded labels at the cutting station improves efficiencies and eliminates several possible identification error points that have traditionally cost labs significant time and resources.

“We modeled our bar code tracking system after FedEx,” Dr. Balis said, referring to the shipping giant’s system that consistently scans bar codes on their packages at virtually every point in the distribution process. “A single mislabeled slide could represent a significant diagnostic error. Using just-in-time identification and tracking methods, of which StainerShield is an intrinsic component, avoids the potential harm to any single patient from a misidentified slide and is, quite simply, quality patient care.”

Like FedEx’ package distribution process, MGH uses bar code technology to track specimens at virtually every point along the lab’s process, starting at the grossing station and ending when the specimen exits the lab for diagnosis. At several points along the way, technicians scan the cassettes’ and slides’ barcodes to help keep accurate track of who, what, when and where.

“Technologically, MGH is light years ahead of its peer hospital groups,” Zimmermann said. “They have combined bar code tracking technology and custom software to extend them beyond what they should be able to do. Using products like StainerShield has allowed MGH to improve patient care and safety while also improving employee productivity.”



Slides await to be processed in the stainer. Each slide is individually identified with specimen-specific data and barcodes printed on a StainerShield label at the cutting station.

General Data Company developed StainerShield, a bar code identification system designed for pre-stainer labeling of tissue and specimen slides, to allow lab technicians to print on-demand, patient-specific bar code labels which can be applied to the slides before specimens are exposed to harsh chemicals, solvents and stains. StainerShield labels are printed using a simple direct thermal printer, and once applied to slides, they are able to withstand the rigors of the staining process without degrading or separating from the slide. Even after staining, the text is readable and the bar codes are scannable. As evidenced by MGH, the labels enable labs to fully utilize bar code technology to improve the tracking process of slides and eliminate potential lab errors that can affect patient safety and patient care.

StainerShield labels do not require a printer ribbon, overlamine flap, or etching system. In one simple printing step, technicians can print slide labels with both text and bar codes that contain data directly from their LIS. StainerShield labels produce consistent bar code labels and text that offer high degrees of scannability before and long after the staining process.

“It is very critical to label slides prior to the staining process,” Dr. Balis added. “An inferior label will dissolve, fall off or lose its legibility and clearly, any of these things happening is unacceptable. StainerShield was the only label that survived our solvents.”

Summary

Just as in 1846 when doctors at MGH performed the first surgery using anesthetic, MGH is once again on the forefront of medical technology and the envy of its peers. While MGH is still early in its deployment of bar code technology, Dr. Balis and other lab directors have created the foundation of a “FedEx-type” tracking system that will help to eliminate inefficiencies and errors, and improve quality patient care and safety. MGH has implemented StainerShield as the “critical” media to interface between lab technicians and the laboratory information system because of the label’s ability to survive the lab’s processes and harsh chemicals. Technicians apply the durable StainerShield labels as slides are produced at the cutting station, assigning a unique bar code identifier to the specimen that enables the slide to be accurately identified and tracked throughout the lab, including archiving and storage. This labeling and tracking system exceeds any current standards and regulations established by the healthcare industry and has clearly set new standards for specimen identification in the lab.