



Making the Transition to Digital Pathology

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Many healthcare organizations today grapple with the issue of providing more effective and scalable pathology solutions to hospitals lacking on-site pathologists. For many, a digital pathology environment that enables pathologists to manage and interpret information originating from the digitization of a glass slide offers a practical alternative to traditional microscopy. As University Health Network (UHN) successfully discovered, a digital pathology platform provides tremendous flexibility through its ability to use the Internet to distribute digital slide images throughout a disparate healthcare system to support the pathology needs of hospitals with no regular on-site pathologist.

Pathology Challenges

University Health Network is a three-site complex located in downtown Toronto. Comprised of the Toronto General, Toronto Western, and Princess Margaret hospitals, UHN is an internationally-recognized leader in patient care, research and education. The Pathology Department at UHN is consolidated at the Toronto General site. Several years ago, in order to provide interoperative consultation, or frozen section services to surgeons operating at the Toronto Western site, UHN installed a robotic telepathology system. The robotic system provided remote pathologists with a live viewing session via use of a robotic microscope that transmitted pathology specimen images to a host computer via telecommunication lines.

During surgery, neurosurgeons obtain small samples of lesional tissue from which frozen section slides are prepared for immediate review and preliminary histological assessment. The main purpose of the frozen section is to confirm the presence of diagnostic lesional tissue. The surgeons are also interested in determining whether the lesion is benign or malignant and the histologic type of the tumor. If malignant, they also need to know whether the tumor is primary or a metastasized cancer from some other body site. Since the assessment takes place during surgery, time is of the essence and both rapid turnaround times and diagnostic accuracy are top priorities for the pathologist. All of this information is crucial in order for the surgeon to decide on the most appropriate intra-operative management for the patient.

Prior to installing the telepathology system, with only one or two cases a day, it was extremely disruptive for the pathologist(s) to interrupt their regular work to travel to Toronto Western to review and report these frozen sections. The robotic telepathology system allowed the pathologist to remain at Toronto General, and review the sample remotely.

The pathologist at Toronto General could view the entire frozen section slide, adjust the focus, and change the objectives and light intensity on the robotically-controlled microscope. The robotic system required the pathologist to review a slide as a series of captured compressed JPEG images. In practice, this meant capturing one field at a time, reviewing the image and moving on to the next field. This process was repeated until the entire slide had been reviewed. In this manner, it took an average of 10 minutes to review a slide and establish a diagnosis. While pathologists were able to meet turnaround time standards of 20 minutes for the majority of cases, in other instances there was little breathing room. In addition, a Histotechnologist needed to be available at the Toronto Western site during the slide review process in the event of a problem with the robotic microscope.

A Digital Pathology Platform Solution

While the robotic telepathology system worked well and provided accurate frozen section diagnoses in a total of 350 cases, the UHN pathologists began to look toward whole-slide imaging as a way to improve the efficiency of their telepathology program. Specifically, in 2006 the group began to investigate the possibility of switching from the robotic microscope to a whole-slide imaging system that would deliver superior image quality as well as a user experience that more closely replicated the viewing of slides with a traditional microscope and, therefore would consistently improve turnaround times and enable pathologists to optimize their time.

The Pathology Department at UHN purchased an Aperio ScanScope™ digital pathology system following the positive experience and results of a colleague at Princess Margaret Hospital who was using ScanScope-created digital slides for a number of research projects and digital pathology initiatives.

Prior to implementing ScanScope, UHN introduced the system to its IT support people, surgeons, and pathologists in advance to ensure they were clear on the process and methodology to ensure smooth implementation of the technology into patient care. The Toronto Western surgeons who required frozen section support were impressed with the Aperio system's smooth operation and crisp images, and fully supported the shift to the digital pathology platform.

The improvement is amazing: using the ScanScope to scan frozen section slides, UHN can now digitize entire glass slides in less than two minutes. The digital slides are then available to the pathologist for immediate viewing from their desktop computer monitor, effectively transforming a computer monitor into a virtual microscope that can be accessed remotely to deliver consistent and accurate results.

While the extra step of scanning the slide added up to two minutes to the telepathology process, the overall turnaround time was reduced due to a significant reduction in the time required for the pathologist to review the slide. Additionally, whereas a robotic microscope required a technician to be present to switch slides or perhaps adjust the robotic microscope, ScanScope can scan, create, and make digital slides available to the pathologist with a touch of a single button. Because slides are scanned in their entirety, a technician is no longer required to make adjustments to the equipment during the slide review process.

Through use of Aperio's viewing software, pathologists have the entire slide at their disposal. They are able

to pan and zoom around the slide at will, creating a familiar and comfortable user experience much more reminiscent of a microscope than the robotic scope could provide.

Benefits Derived

UHN has been very pleased with the high quality digital slides created by ScanScope, especially given that frozen sections are often suboptimal tissue samples that can be further compromised by processing artifacts. Outstanding image quality is critical to a telepathology program's success, and Aperio's patented linear array scanning technology creates an optimally focused digital slide free from artifacts or the optical aberrations characteristic of tiling methods.

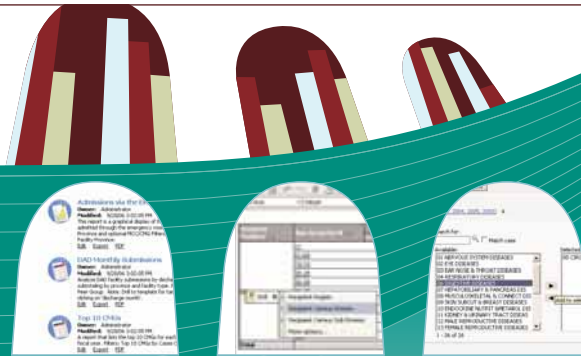
Launching a telepathology program using a digital pathology platform has significantly improved UHN's pathology workflow for remote intra-operative consultations. Pathologists prefer the Aperio user interface and viewing experience, and have shaved precious minutes from their turnaround time. Resource optimization through the substantial savings of the pathologist's time is one of the most powerful benefits of the system.

One feature that proved to be quite useful to UHN pathologists was the system's ability to conduct multiple viewer-conferencing on difficult cases that require additional consultation in a timely manner. Historically, pathologists have had to summon colleagues to physically leave their offices for these extra opinion reviews. Using digital slide conferencing, pathologists

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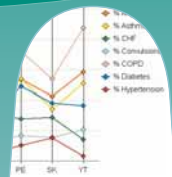
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Reviewing a frozen section.

can simply access the slide from their desktop computers with minimal disruption or delay. They are also able to take turns controlling the cursor to point out different aspects of a given slide. This has proved to be a more efficient method than physically aggregating in one room.

UHN's experience using ScanScope within its three Toronto-based hospitals has been so successful it is now working on a partnership with a group of under-served hospitals in Northern Ontario. With a significant shortage of pathologists in the area, this district is looking at ways to shift some of the pathology workload to UHN in Toronto. Telepathology is the only feasible option for providing remote frozen section support, and digital slide technology provides a viable and cost-effective way to provide this service to remote regions.

While the primary focus is on clinical applications, UHN has also found benefit in research and educational uses. On the research side, Princess Margaret Hospital, which also houses the Ontario Cancer Institute, provides basic research on cancer and is performing studies such as correlating histologic slides with MR and CT scans. Such a project is greatly enhanced by the use of digital slides.

In the educational arena, UHN believes that all pathologists will eventually need to be able to read digital slides. Toward that end, it has started building archives and

digital slide teaching sets that will be used as a teaching resource for pathology residents and fellows.

Next Steps

UHN is expanding telepathology on a number of fronts. A major focus is the Northern Ontario project, which may ultimately implement scanners at 11 hospitals in the region. Closer to home, Toronto Western will be expanding its scope of surgery, which will generate more frozen sections for assessment by telepathology.

Another exciting use for digital pathology under consideration is to offer this service to the UHN multi-organ transplantation program. Rush biopsies are often required to determine whether a patient is rejecting a transplanted organ. These biopsies often arise in after-hours situations, where time is of the essence and a pathologist is not likely on-site. The ScanScope system would provide pathologists with fast, remote access in these critical situations.

A digital pathology platform has helped UHN successfully equip its pathologists with a solution to better manage and analyze information in a disparate environment to deliver faster and more efficient pathology services. ●