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Digital Pathology: The Diagnosis is Rapid Growth, Greater Demand for Integration

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Improvements in slide scanning, image management and analysis technologies, and are pushing digital pathology systems forward. At the same time, the demand for faster, more accurate diagnoses is increasing. The result? Market researcher Frost & Sullivan has estimated that digital pathology hardware and software systems could become a \$2 billion industry during the next decade.

However, formidable hurdles remain. Among them are the high price point of these systems, still-massive storage and data compression requirements, lack of integration with [laboratory information systems](#) (LIS) and workflow disruption. In addition, because slides are still at the center of digital pathology, physical storage issues remain as well. The [College of American Pathologists](#) (CAP) requires that glass slides be maintained for 10 years—even if they are scanned and converted to digital images.

But the momentum is building in digital pathology because digitized images provide more detailed information. Slides can stay in one location, yet clinicians anywhere can look at them “independent of time zone or geography, and you also can have a collective collaboration,” says [Keith J. Kaplan](#), MD, a pathologist and writer at [Digital Pathology Blog](#).

Digitized slide images also are gaining importance in telepathology, quality assurance studies, education and research, adds [Anil Vasdev Parwani](#), MD, PhD, director of the division of pathology informatics at the University of Pittsburgh School of Medicine.

Pathology is taking its cue from the radiology department, where x-ray films have been largely replaced with digitized images. Today, digital scanners are used in many centers for sharing images internally and for collaboration among pathologists in different hospitals. But none of them have fully integrated digital pathology into the workflow—and without that integration, digital pathology cannot be used for primary [diagnosis](#), says Parwani.

In a typical digital pathology workflow, cases are sectioned in the pathology lab, slides



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are created and scanned into a LIS, and pathologists review the images on a desktop or PC. Integration with LIS, still on the horizon, will enhance the reporting capability within the digital environment.

In 2008, the University of Pittsburgh Medical Center ([UPMC](#)) partnered with [GE Healthcare](#) to form Omnyx, a joint venture to build and market a digital pathology system. This fall, UPMC will use the Omnyx technology to integrate its LIS and digital pathology system, says Parwani.

Quantitative advantage

[Mariano de Socarraz](#), CEO of [CorePlus](#), a specialized anatomic pathology service based in Miami, says he's seen increased interest in digital pathology over the last three years.

CorePlus, which contracts with Miami area hospitals and reference physician offices, uses BioImagene's iScan Coreo slide scanning system and Virtuoso digital pathology software, Socarraz says. Slides can be scanned and uploaded in 2 to 3 minutes—which results in faster diagnosis and reports, and enables more timely expert or subspecialty consultations, he says.

“You can do quantitative analysis with the digital image more accurately and in addition, you have access to the patient's prior [results] within minutes in a digital workflow,” Parwani says.

Socarraz says his team has integrated quantitative [image analysis](#) into their pathology workflow so that positive cases are digitized, quantified and presented to the pathologist, who interprets the results and sends them to a separate reporting platform, where they are included in the final report.

Before CorePlus implemented the system, qualitative assessment was based on pathologists' interpretations as they viewed the slide. With cell-level quantitative analysis, that potential variability is taken out of the equation, Socarraz says.

In breast cancer cases, for example, CorePlus' iScan Coreo/Virtuoso system analyzes cells for estrogen receptor (ER), progesterone receptor (PR), and oncoproteins HER-2 and Ki-67, and uses the analysis for prognostic planning and therapeutic information. CorePlus plans to digitize hematoxylin and eosin (H&E) analysis, and Socarraz envisions the next area for digitizing will be cytology.

Because of the CAP's 10-year slide storage and maintenance requirements, one of the prerequisites of any digital pathology system is that labs bar-code all slides, which decreases the chance of loss and damage, says Parwani. In a conventional system, 10 to 15 percent of pathologists' time is spent organizing slides for image viewing, so



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digitizing that process can increase a pathology department's efficiency, he adds.

Falling barriers

Although image storage is still a challenge, a single-terabyte server/workstation can now retain about 2,400 images, which can be compressed to conserve space, yet retain very high diagnostic fidelity, Kaplan says. "[Depending] on the volume of slides and the volume of images that you are going to collect ... not everybody may need 10, 20 or 30 terabytes of storage," he adds.

Hardware price points are still steep: For example, a typical multislide scanner can cost \$200,000 in addition to the cost of image storage, says Parwani. Each scanner takes 2 to 3 minutes to scan each slide, and a small lab with 500 to 600 slides will require two scanners to keep up with workflow, he predicts. Easing the financial burden somewhat are equipment lease arrangements or reagent use agreements, in which facilities are charged on a pay-per-click basis. For example, a vendor may provide the pathology software and scanning equipment, and a facility pays for slides scanned or image analysis.

"With the leased arrangement, you can perhaps upgrade into a newer [scanner] model in two or three years that has more tools built into it," Kaplan says. Web-hosted slide scanning services also are available, he adds.

Behavior and pathology

Another roadblock to adopting digital pathology can be the pathologists themselves. "People have to transition from an analog environment to a digital environment, and you have to prove that this is going to benefit them," says Socarraz. "[You] have to have a champion in the organization who sees the value of digital pathology, along with support from stakeholders."

Beyond service, there is no reimbursement from payors, "so you really have to justify it based on other criteria, because the digitalization is not going to increase revenues," he says. "Users reap their return on investment in time and cost savings related to greater efficiencies in workflow, reduced shipping costs, decreased errors, and improved accuracy."

Image integration

Farther out on the horizon is the integration of digital pathology with imaging. The Digital Imaging and Communications in Medicine (DICOM) standard will provide a format for whole slide images to be used in a PACS environment and PACS vendors will be able to present the pathology images, Kaplan says. That will allow, for example, the



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opportunity to have an enterprise line on applications on the hospital PACS, he predicts.

“Next you need to have the reporting capability,” which may be within the PACS or within an LIS application, he suggests.

Digital pathology will continue to move forward as more clinicians understand its potential to improve diagnoses and thus treatments for an increasing number of conditions. “The overlay between imaging and pathology also is going to be a driver to adopt these technologies,” says Socarraz, “and it is just the matter of time.”