



P.30 >
CHALLENGES IN
NEWBORN SCREENING

P.34 >
ISSUES, UPDATES
IN HIV TESTING

P.40 >
CONVERTING TO
DIGITAL PATHOLOGY

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P.12 >
PLUS...
THE MOLECULAR EDGE:
KRAS DIAGNOSTIC TESTING

P.18 >
**CRITICAL ISSUES IN
ANTIMICROBIAL
SUSCEPTIBILITY
TESTING**

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1

CONVERTING TO DIGITAL PATHOLOGY

By Ole Eichhorn

One expert provides tips for selecting the right digital pathology system.

Digital pathology systems allow pathologists to manage and interpret information more efficiently. They offer software for remote viewing, slide conferencing, image analysis and intelligent archival and retrieval. Most importantly, they improve pathology workflow, resulting in lower costs and improved patient care.

However, not all digital pathology solutions are created equal. Here are important system specifications to consider when evaluating a digital pathology systems vendor.

Experience and Approach

A solid installed customer base and history of product improvement will provide a good indicator of a product's strength. Look for a vendor who has installed hundreds of systems and has received positive customer references. Don't be shy about asking for this information.

It is critical to making a good decision. It is important to select a vendor with a broad portfolio of digital pathology products and services to meet diverse needs, as well as a commitment to the digital pathology market, with appropriate focus, ongoing product development, experience and infrastructure to provide needed support. A company with a complete solution for digital pathology, including scanners, digital slide management, image viewing and sharing, image analysis capability and specific applications such as tissue microarray (TMA) and digital IHC solutions will simplify your life in the long run when you find you do need certain functionality down the road.

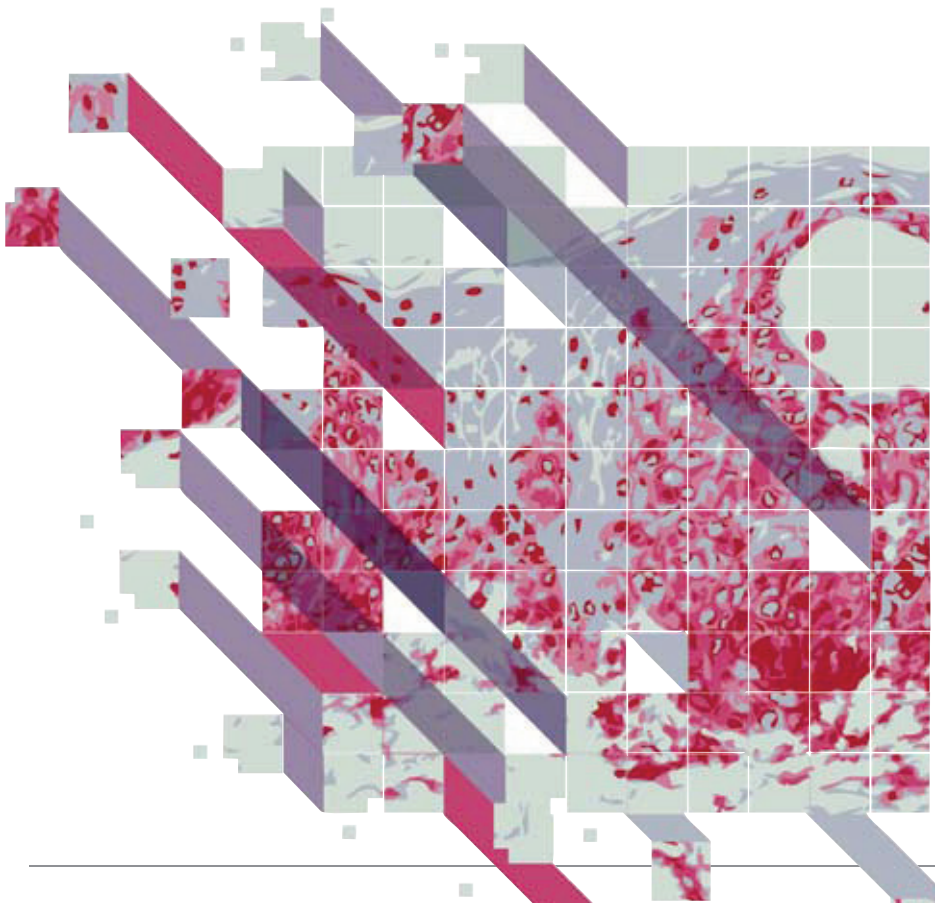
Choose a vendor who will work with you to understand the best path for adoption of digital pathology at your institution; this includes identifying the best application with which to start as well as other applications. It is also helpful to have a company that offers customer support with extended hours in the event of technical problems and one that provides user training courses and certification.

System Design

Overall digital pathology system design is important to ensure robust operation, maintainability, integration with other systems and scalability. Look for an open system architecture. Does the system use standard formats and enable easy integration with other systems (e.g., LIS, LIMS, PACS, etc.)? Can the system be extended by third parties with additional image analysis applications?

Multi-site capability is an important consideration for larger institutions. Digital pathology systems often start with a simple installation at a single location, but multi-site configurations ensure you will not outgrow the system as your usage of digital pathology evolves.

Digital pathology systems have several components such as scanning instruments, servers and viewing workstations, which communicate on your network. A solid network architecture provides efficient and secure operation and clean integration with other network systems. Get your IT team ▶▶



involved early in your evaluation process. Experienced vendors recognize the importance of IT and welcome their involvement.

Image Quality

An important attribute of any digital pathology system is slide image quality. Consider scanning a representative set of glass slides on all candidate scanners under the same conditions to evaluate digital slide image quality from your potential vendor. Key considerations for image quality include clear, well-focused images free of aberrations, visible seams and alignment artifacts and available resolution of the digital image in $\mu\text{m}/\text{pixel}$. As a rule of thumb, 20X images are generally $.5 \mu\text{m}/\text{p}$, and 40X images are $.25 \mu\text{m}/\text{p}$.

Support of higher numerical aperture (NA) objective lenses is necessary to produce higher quality digital slides. Some systems use lower NA objective lenses that cannot deliver the resolution claimed. Scanners that support International Color Consortium profiles ensure color accuracy and consistency among scanners and viewers along with reproducibility and compliance; use of JPEG2000 compression yields the highest image quality.

Slide Creation

The ease and speed at which slides are captured are vitally important. Evaluate the length of time it takes to scan a batch of slides. Scan time estimates should include time to load/unload, scan, compress and write digital slides to disk as well as post-processing required

before slides can be viewed. Systems making slides immediately available for viewing are preferred, and one-touch, walk-away automation whereby the system auto-scans the slide without operator intervention is desirable.

Take into consideration the re-scan rate, since quality assurance review and rescanning will be part of your overall throughput, and the capability to scan stat slides while a batch is being scanned may become vital for acute settings. Ask vendors for customer references to verify real-world performance.

Barcode support and auto-scanning of non-barcoded slides should be possible as well as the ability to store digital slides as a single file, to simplify management. Some scanners store multiple constituent individual files, making file management difficult. If your institution requires the ability to scan 2 x 3-inch slides, know that some scanners cannot handle larger format slides.

You may need the ability to create z-stacks, which enable multiple focus planes to be captured and viewed for applications such as cytology where specimens are thicker than the focal distance of the objective lens. As well, you may require a dedicated, high-resolution oil immersion scanner or scanner upgrade for hematopathology and microbiology applications that require the higher magnification provided by oil objectives.

Slide Viewing

The best way to evaluate a viewing solution is to use it in a typical environment. Look for

open viewing software as well as good performance over wide area networks.

Likewise, performance of remote viewing capabilities should be evaluated in real-world situations, using a cloud-based server. Many vendors provide online galleries of images that can be used for this purpose.

Choose an easy-to-use format so busy pathologists can rapidly view digital slides by instantly panning and zooming without taking their eyes from the screen. Also look for these capabilities:

- annotation that does not modify the original image data,
- digital conferencing whereby remote parties can simultaneously view and annotate the same digital slide synchronously,
- multiple, side-by-side (preferably synchronous) viewing of slides, and
- regional export for publication and reporting.

Software that can manage thousands of digital slides from multiple scanners, support different formats/types of compression and offer role-based user access will enhance workflow and flexibility, while auditing trails and reporting for compliance purposes assist with HIPAA and good laboratory practice (GLP) compliance. User-defined fields to tailor systems to specific workflow and searching requirements, and interface capability to an LIS or LIMS are a must.

Image Analysis

The analysis of gigabyte-size digital slides using image analysis software is technically challenging but important. Look for a scalable image analysis solution that can process large volumes of images in a batch mode without user attention. Many facilities will want FDA-cleared applications for prognostic applications like HER2, ER and PR quantification.

Image analysis of user-selectable regions and/or the entire slide is helpful as well as the ability to exclude regions of a digital slide from analysis. Support of third-party algorithms preferably through an open interface gives you a wider range of choices of applications, and means you can even build your own. ■

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