



White paper

AI in digital pathology: facilitating research and monetizing assets



Summary

The fast pace of artificial intelligence (AI) is galvanizing the field of pathology, building on the digital pathology paradigm shift. Automated workflows, timely collaboration, and the inclusion of AI tools are becoming standard practice. What does this mean for pathology? Quite a bit in the way of advancing research and deriving more value from pathology assets.

Contents

3/ Understanding digital pathology

4/ Exploring the rise of AI in digital pathology

4/ Supporting research and education

4/ Maintaining quality standards

4/ What about generative AI?

4/ Expanding research horizons with digital pathology and AI

5/ Translational research

5/ What's slowing your pathology research?

5/ The benefits of AI in pathology

6/ Increased efficiency

6/ Enhanced quality

6/ Monetizing the value of pathology assets

6/ Eight tactics organizations can leverage

8/ Next steps

8/ Getting to know Iron Mountain Digital Pathology solutions

8/ The importance of academic-industry partnerships

AI in digital pathology: facilitating research and monetizing assets

Understanding digital pathology

Advances in digital pathology can be thrilling, promising significant benefits to medical research and collaboration. The advent of digital pathology delivers an image-driven environment where pathologists can better understand medical events, train students, and contribute to research.

Whole slide images (WSIs) serve as valuable assets—information that can be acquired, managed, shared, and interpreted. Globally, the digital pathology market is expected to increase at a compound annual growth rate of 8% through 2030. With this growth comes many benefits. Pathologists anticipate a faster, more precise understanding of diseases affecting individuals and global populations.

Technology solutions, especially those designed to boost efficiency, can serve a dual purpose. Digital pathology platforms will enable effective collaboration across time zones and borders—bringing experts together quickly. Access to whole slide images will reduce time spent waiting on physical slides to support pathology work anytime, anywhere.

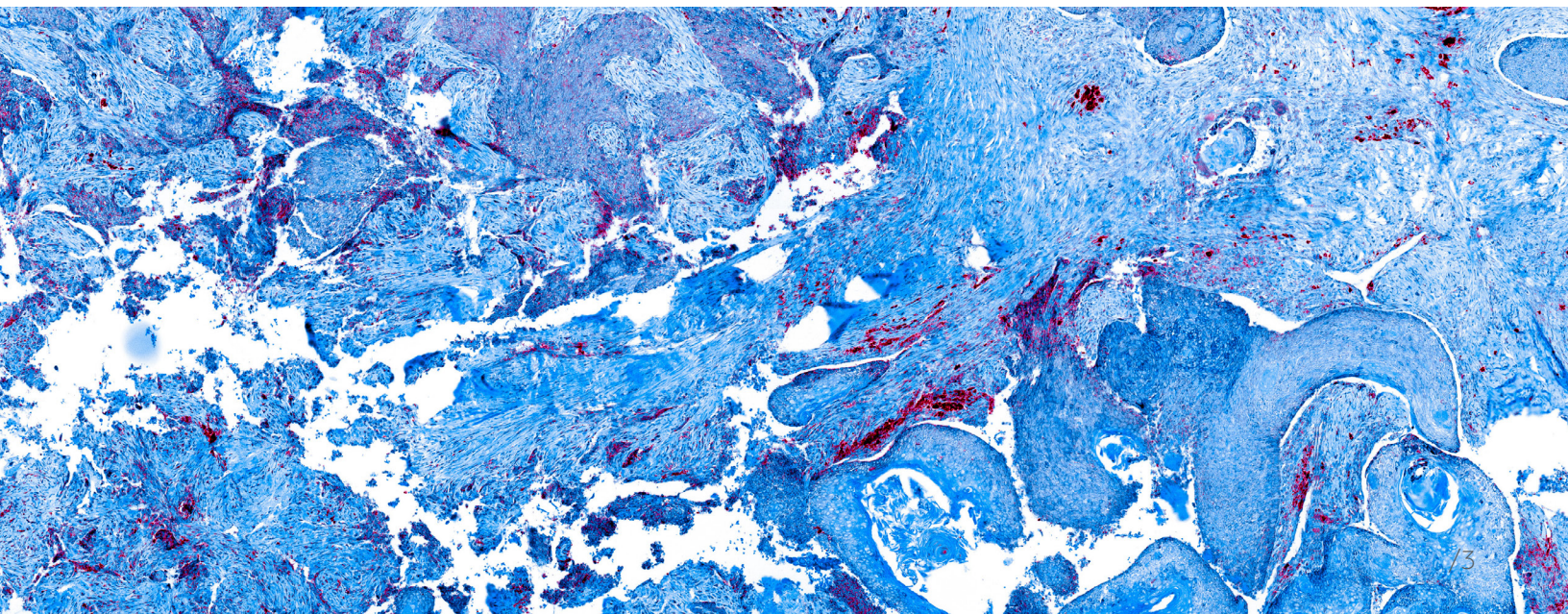
Enhanced with AI, digital pathology systems will speed up each step, from image scans to tissue analysis.

And access to digital pathology platforms will support comprehensive education and training using rich data sets and annotations from a variety of collaborators.

Already, digital pathology is easing collaboration among pathologists regardless of their physical locations. Digital samples are readily accessible when a specialist or second review is needed. Across geographic regions, pathologists can reach underserved populations and improve diagnostic confidence. These capabilities can positively impact resource shortages and enrich education, especially in research settings and in developing nations.

With digital pathology, the pathologist can take advantage of AI and other technology tools to perform critical measurements, image and historical analyses, and pattern recognition. Research integration with AI machine learning shows significant potential in detecting disease patterns and predicting outcomes. These technologies also reduce cost and risk for providers, labs, and other healthcare organizations via offsite storage and cloud capabilities. Workflow automation and AI algorithms enable substantial time savings as well.

Source: [The Pathologist](#)



What about generative AI?

Just as generative AI tools—such as large language models and multi-modal models—are impacting other professions and disciplines, so will they affect pathology. Specialized AI and machine learning systems have already matched, and in some cases surpassed, human abilities in areas such as image analysis. However, these AI models require adequate training and massive volumes of accurate data.

Now, a more flexible kind of model for generative AI is gaining traction. Foundation models are big AI systems trained on huge data stores that can be fine-tuned for specific tasks. These models learn from mistakes, require less additional data, and can adjust based on feedback.

A pathology-specific generative AI, based on foundation models, may serve as an expert companion to pathologists. It could add greater efficiency and objectivity to routine laboratory tasks such as quantifying image analysis, or generating reports, diagnosis, and prognosis. Foundation models and generative AI could also help standardize the pathology laboratory workflow, education and training.

Source: Laboratory Investigation

Exploring the rise of AI in digital pathology

AI stands to transform how pathologists analyze WSIs, as well as how they approach research, teaching at conferences and virtual workshops and presentations before tumor boards.

Supporting research and education

AI tools enhance the training of future pathologists by offering easily accessible digital slides that can be shared and viewed remotely. Such technologies might include features like automated quizzes to test trainee knowledge or the ability to create synthetic digital slides for educational purposes. In fact, the College of American Pathologists now provides WSIs alongside traditional glass slides for certain proficiency tests. For research, high-speed, high-resolution digital slides can be used in remote consultations and for assessing the consistency of diagnoses among pathologists. The availability of massive volumes of data and AI analysis tools allow disease researchers to grow their knowledge base and find deeper insights.

Maintaining quality standards

It's challenging for pathologists and radiologists to stay updated on all medical conditions. Regular interactions and feedback, whether through manual review or AI

tools, can help researchers and practitioners refine their skills and keep current with new diagnostic methods. AI can assist in routine quality control processes or as part of formal assessments in pathology labs. It also acts as a safety measure by double-checking pathologist assessments using automated algorithms, ultimately improving accuracy.

Source: The Lancet Oncology

Expanding research horizons with digital pathology and AI

Advances in technology have excited the pathology discipline. Pathologists are talking about uncovering new biomarkers and disease associations and enabling large-scale population studies. Such excitement and a growing emphasis on precision medicine are driving further development of AI-infused digital pathology methods.

One buzzword, translational research, is gaining a lot of attention and is predicted to attract a fair amount of funding in the next several years. Translational research centers on turning research findings into practical treatments for patients. Digital pathology and AI applications can support this research model by improving quantitative accuracy and lending geographic context to data via spatial algorithms.

Translational research, which moves discoveries from the lab to the clinic and back again, is becoming more important in medical research. However, it's a relatively new area that warrants proper discussion about ethical implications.



Key takeaway:

Integrating digital pathology and AI into traditional methods provides more precise and consistent results that can be easily shared and accessed by fellow pathologists—furthering research.

What remains evergreen is the traditional role of pathologists. They will continue to deliver diagnoses and assess biomarkers for companion diagnostics. Benefits of AI and digital pathology—such as precision, reproducibility, and scalability—are already helping pathologists do their important work.

AI-based solutions and WSIs help pathologists analyze and understand specimens in ways that go beyond what the human eye can see. These advances can increase the accuracy of measurements and enable pathologists to analyze data in new ways, like looking at the spatial distribution of cells. This may be especially helpful in predicting how patients will respond to treatments.

In the field of immuno-oncology, these new approaches are being applied to drug development and research. This allows pathologists to better understand complex diseases and find new ways to treat them. For example, in the tumor environment, pathologists can more quickly match patients with the right treatments based on their specific conditions.

Source: [Modern Pathology](#)

The benefits of AI in pathology

The physicians who study disease are already testing AI-based machine learning, image recognition, and other assistive technologies. Of course, AI could never replace the cognitive abilities, extensive education, and valuable experience of a pathologist. It's more fitting to see AI as a tool pathologists can use—one that delivers greater efficiency and consistent quality.



What's slowing your pathology research?

Healthcare and life sciences organizations are challenged to manage an ever-growing volume of slides and blocks while maintaining inventory integrity and timely access to physical slides. As the volume of specimens continues to grow, it's increasingly more difficult to:

- Gain quick access to the slides for review and research
- Facilitate efficient collaboration
- Manage the proper storage and movement of assets

Organizations can stay competitive in a fast-approaching digital pathology future where AI capabilities and collaboration via a digital image library will be standard practice. This means streamlining digital access to large sets of archival images used to facilitate research, train AI models or be monetized via marketplaces.

For researchers wanting to create a rich in-house digital medical image archive, large slide sets in storage can be scanned and uploaded to a secure cloud. These images can then be viewed by pathologists, analyzed digitally or used to train machine learning algorithms. Researchers can more easily collaborate using quality slide images stored in a digitized library.

Source: [Iron Mountain](#)

Experts solicited by the World Economic Forum expect emerging technologies like AI and machine learning to help bridge equity gaps and transform global health outcomes. They see the potential for AI to improve data analysis, medical diagnosis, and healthcare delivery. In the near future, AI-driven predictive models are expected to support disease prevention and assist in creating personalized treatment plans.

Forward-thinking pathologists have partnered with AI to automate mundane tasks, facilitate collaboration, and grow the potential of disease research.

Pathologists are reporting significant benefits to AI-infused digital pathology, as follows:

Increased efficiency

AI and digital pathology together enable the automation of routine, time-consuming tasks including image annotation and data organization. Pathology workflows streamlined by AI give pathologists more time to focus on complex decision-making.

With the help of pathology experts, AI can be trained in more advanced skills. Innovative AI applications in tissue and cell imaging perform rapid feature detection and quantification—identifying and quantifying cell count, shape, and distribution. This means researchers see results that are more consistent and less prone to errors.

In one recent study, pathologists who used an AI tool designed to detect and quantify mitoses reported an overall time-savings of 27.8% compared to manual methods. A research conclusion noted, “Pathology end-users were more accurate and efficient at quantifying mitotic figures in digital images of invasive breast carcinoma with the aid of AI.”

Enhanced quality

Similar to how AI performs in other arenas, AI algorithms for digital pathology can analyze massive amounts of data with high levels of precision. This enables AI to assist pathologists in working with patient records and other large datasets. In addition to efficiency gains, the capability helps pathologists detect patterns and anomalies, such as rare subtypes or unusual features, with consistent levels of accuracy.

AI shows promise in supporting and even standardizing the pathologist’s work on tumor grading, for example. In a real-world clinical application of an AI algorithm for breast cancer detection, researchers made a startling discovery. They found significant discrepancies in scoring among four participating pathologists. Meanwhile, the AI scoring returned consistent results.

By collaborating with AI, pathologists achieve a more comprehensive analysis—via a ‘second set of eyes’ to cross-check assessments. This assistance can lead to better-informed treatment plans, improving patient prognoses via early detection and targeted therapies.

Sources: *World Economic Forum, What can artificial intelligence do to tissue and cell imaging?*, *Diagnostic Pathology, NPJ Breast Cancer*

Monetizing the value of pathology assets

Digital pathology together with AI can increase operational efficiency, reducing the cost of diagnosis and reporting and optimizing resource allocation. It also opens up opportunities to capitalize on telepathology for remote consultations, second opinions, global outreach, and market expansion. Plus, organizations can unlock revenue streams through data, the commercialization of research findings and by licensing AI algorithms or related technologies.

The objective is to monetize the value of pathology assets while advancing patient care, research, and innovation by **strategically leveraging any of the following eight tactics**.

- **Clinical services:** Pathology assets can generate revenue through diagnostic testing, biopsy analysis, and consultation services to healthcare providers and patients.
- **Research collaborations:** Tissue samples, databases, and expertise can be valuable for research collaborations with pharmaceutical companies, biotech firms, and academic institutions. Such alliances can lead to licensing agreements, research grants or royalties from resulting products and discoveries.



- **Education and training:** Medical training programs, continuing medical education courses, and workshops can generate revenue through tuition fees, certification programs, and sponsored training events—all made more desirable with advanced digital pathology practices in place.
- **Telepathology services:** With advancements in digital pathology and telemedicine, remote pathology consultation services can be offered to healthcare providers and institutions such as virtual tumor boards worldwide.
- **Diagnostic software and tools:** Image analysis tools and AI algorithms aimed at improving the accuracy and efficiency of pathology diagnostics need good data. Revenue can come in the form of software licensing, subscription fees, and sales of associated hardware.
- **Biobanking and tissue sales:** Tissue samples, biofluids, and pathology archives can be sold to researchers, pharmaceutical companies, and diagnostic laboratories for use in biomarker discovery, drug development, and clinical trials while protecting patient information.
- **Intellectual property:** Patents, copyrights, and proprietary algorithms related to diagnostic methods, medical devices, or therapeutic targets can be monetized through licensing agreements, patent sales, or the development of commercial products.
- **Consulting services:** Expertise in pathology and laboratory medicine can be offered as a service, such as advising healthcare organizations on laboratory operations, quality assurance, regulatory compliance, and strategic planning.

Sources: [Academic Pathology](#) and [PR Newswire](#)

The importance of academic-industry partnerships

The idea of an Academic Industry Partnership (AIP) calls for crucial teamwork between academic researchers and businesses. The mission is to turn technology into real-world solutions within academic health systems. The Digital Pathology Association believes AIP to be crucial for moving technology, including AI and digital pathology, from labs to clinics. These partnerships encourage innovation and speed the development of marketable products.

Source: [Digital Pathology Association](#)

Next Steps

Getting to know Iron Mountain Digital Pathology solutions

Researchers can reap the rewards of digital pathology by partnering with a capable and reputable digital pathology service provider. To help unlock access to large sets of archival images, Iron Mountain offers a digital pathology archival digitization capability as one option available in its end-to-end Digital Pathology solution.

The Digital Pathology solution streamlines access to large sets of archival images that can be used to facilitate research and train AI models or be monetized via marketplaces. The solution promotes the ability to source digital slide images, collaborate efficiently on research, and manage a digital image archive securely and cost-effectively.

For researchers wanting to create a rich in-house digital medical image archive, large slide sets in storage are scanned and uploaded to Iron Mountain's [scalable Iron Cloud storage solution](#).

Iron Mountain maintains 850 million patient records, 1 billion+ medical images and 1 billion+ pathology slides in its secure storage.

About Iron Mountain

For over 70 years, Iron Mountain Incorporated (NYSE: IRM) has been your strategic partner to care for your information and assets. A global leader in storage and information management services and trusted by more than 225,000 organizations around the world, including 90% of the Fortune 1000, we protect, unlock, and extend the value of your work—whatever it is, wherever it is, however it's stored.

We create the framework necessary to bridge the gaps between paper, digital, media, and physical data and extract value along its lifecycle, helping to build your organizational resilience. And all this with a commitment to sustainability at our core.

Our relationship is a true partnership where you trust us not only to preserve institutional knowledge and enhance efficiency, security, and access but to make your work mean more. Because in that work is the power to not only accelerate your business but elevate it.

Trusted by more than 225,000 organizations around the world, and with a real estate network of more than 85 million square feet across more than 1,400 facilities in over 60 countries, Iron Mountain stores and protects billions of valued assets, including critical business information, highly sensitive data, and cultural and historical artifacts. Providing solutions that include [information management](#), [digital transformation](#), [secure storage](#), [secure destruction](#), as well as [data centers](#), [cloud services](#), and [art storage and logistics](#), we help customers lower cost and risk, comply with regulations, recover from disaster, and enable a more digital way of working—and all this with a commitment to sustainability.

As an experienced global service provider, Iron Mountain can help healthcare organizations of all sizes. Enterprises worldwide rely on Iron Mountain to store, protect, and manage their assets and information. This includes over 2,000 healthcare customers, the Top 10 global pharmaceutical companies and 94 imaging centers that digitize more than 1.5 billion documents annually.

Iron Mountain provides:

- › Pathology physical slide and block storage
- › Cloud storage and migration services
- › Data centers and colocation services
- › Document scanning and digital storage
- › Information governance advisory services
- › Information management and content services

Iron Mountain offers end-to-end Digital Pathology solutions consisting of services and flexible capability components including On Demand or Archival Whole Slide Imaging (WSI) digitization, WSI digital viewing, and digital and physical slide storage - accessed through its image management system SaaS application.

For more information,
visit www.ironmountain.com/pathology



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