Taking Pathology to the Cloud

How Cloud Solutions Can Revolutionize the Growing Field of Digital Pathology

November 2015

To learn more about what Proscia can do for you, get in touch at:
info@proscia.com   |   www.proscia.com
Abstract

Pathology labs are leveraging critical technological improvements to react to challenges within the industry, including a growing pathology supply burden, diagnostic subjectivity, diverse workflow desires, the capital expense burden, and global disconnectivity. This white paper formally illustrates the impact of a cloud-based infrastructure and how this technology is particularly powerful when applied to the problems faced by pathologists and hospital IT professionals today. In addition to providing a brief overview of the current problems faced in the pathology industry, this report discusses potential benefits of cloud computing and hindrances to its growth in this field, and concludes with a forecast of the future state of the pathology field.
Contents

1. Background: Pathology Then and Now

2. The Pathologist’s Quandary
   2.1 Pathology Has a Manpower Crisis
   2.2 Standardization and the Struggle for Diagnostic Consensus
   2.3 Workflows Are Diverse: Can One Size Fit All?
   2.4 The Capital Expense Burden
   2.5 How Global Disconnectivity Silos Expertise

3. The Solution: Taking Pathology to the Cloud
   3.1 Doing Cloud Right: Backbones, Not Band-Aids
   3.2 Capital Expense Burden: Eliminated
   3.3 Scale Computing Resources On-Demand
   3.4 With Cloud Comes Global Access
   3.5 A New Solution for Adaptive Workflows

4. Addressing Common Misconceptions
   4.1 Cloud is Best (Yes, Best) for Security & Privacy
   4.2 Making the Switch Is Easy

5. A Cloud Prognosis: What the Future Holds
1. Background: Pathology Then and Now

Quantitative digital image analysis dramatically changed the radiology industry two decades ago. As a result, experts were given access to powerful empirical data that aided diagnostic practices. Likewise, anatomic pathology is undergoing changes that closely parallel the recent technology shifts of radiology. New biomarkers, microscopy techniques, slide digitization, and other technologies have added many robust capabilities to the pathology lab. With these advancements, the field of pathology is ready to undergo a dramatic technological revolution with clinical impacts similar to those seen in radiology.

The initial hurdle to digital pathology throughout its formative years in the late 1990s and early 2000s was the challenge of digitizing pathology samples. Traditional pathology has, for the past century and a half, relied nearly exclusively on microscopy for visualization of tissue biopsies. This has posed significant problems regarding sharing of information and storing copies of the samples. While an image could be captured and stored via microscope-mounted cameras, there are two major drawbacks with this practice. First, the high resolution of the image must be preserved, and second, many regions within one sample must be captured. Camera-based pathology, while able to meet these needs in some situations, only does so to a limited extent and requires untenable amounts of work and time from the pathologist.

The advent of whole-slide scanners starting in the late 1990s, and their more significant adoption in the past 5 years has revolutionized the field and brought new life to digital pathology. These whole-slide scanners are capable of generating high-resolution digitized images of whole biopsy slides for multiple samples at a time. The image files are hosted and visualized either locally or on a network, and have allowed a pathologist to view on a computer monitor rather than through a microscope. They have also set the stage for a major shift in pathology towards digital tools for image capture, sharing, storing, annotation, and analysis.

However, while scanners have sparked the initial development of digital pathology, they are not, in and of themselves, a complete solution, and fail to address many of the needs that pathology still faces. Addressing these unmet needs is the next step in development of digital pathology. The next steps of creating a completely digitized workflow include perfecting the hardware, infrastructure, and software to create a seamless workflow. One of the more recently developed approaches to addressing the needs of digital pathology that has demonstrated impressive success is cloud-based digital pathology. The ultimate consequence of the adoption of cloud-based digital pathology is improved quality of care for the patient, increased efficiency for the clinician, and decreased upfront expenses for the hospital.
2. The Pathologist’s Quandary

Pathology markets are undergoing rapid technological growth in order to address constraints that currently hinder efficiency and create a largely overburdened workforce. These advancements address the declining capacity of the international workforce, subjectivity surrounding the diagnostic process, diverse needs of unique segments of the workforce, and the restrictions associated with capital expenses.
2.1 Pathology Has a Manpower Crisis

The pathology field is facing a pathologist supply and clinical demand crisis that places a global burden on the healthcare industry. The College of American Pathologists estimates that there will be a 25% deficit of pathologists in the US by 2025 compared to the forecasted need. In 2010, there were 17,986 active pathologists in the US, but by 2025 this number is predicted to fall to below 15,000 active pathologists, while anticipated demand continues to grow to above 20,000 pathologists. The year 2015 marks the tipping point after which the net workforce is predicted to decrease annually. This trend in pathology supply in the US is being driven largely by the retirement of baby-boomers; approximately 75% of active pathologists are 45 or older and are expected to retire within 20 years. Meanwhile, there is no indication of any increase in the number of pathologists being trained. As a result, a fewer number of pathologists will be taking on a larger amount of cases. Without a dramatic shift in training or technology, each pathologist will need to increase their workload by as much as 40% in order to accommodate the growing need for and declining availability of clinical pathologists.

This problem of supply and demand of pathologists is even more prevalent outside of the US. The number of pathologists-per-capita in many countries is significantly lower than in the US, ranging from 1 pathologist for every 26,500 people in Hong Kong to 1 pathologist for every 103,300 in Malaysia. As access improves to basic healthcare in the developing world, pathology departments have struggled to supply the necessary human capital to meet the influx of new patients. With the number of new cases expected to rise by 70% over the next two years, the global pathology workforce is facing rapidly encroaching labor constraints. Currently, the distance and the time involved in transmitting samples, especially internationally, is constricting the pathology workforce into silos. In an economy that has shifted towards globalization, the global pathology industry is operating far below potential.
2.2 Standardization and the Struggle for Diagnostic Consensus

The gross, microscopic, and molecular examination of human tissue provides the highest detail analysis in the diagnostic process for a patient. Anatomic pathologists are responsible for providing the great scrutiny and precision to deliver potentially life-altering diagnoses. Substantial skill and experience is required in order for a pathologist to recognize the plethora of variations in disease and provide a diagnosis that ensures the correct treatment for every patient. Variation arises as a result of the largely qualitative analysis of such nuanced elements of human biology and directly impacts clinical outcomes.

This variation is not a consequence of the skill level of the pathologists, but is derived directly from the qualitative nature of pathology criteria and standards.

These conventions are based on non-quantitative patterns, often with non-descript distinctions from one score to the next, contributing to incongruity in diagnoses and treatment quality. For example, prostate cancer is most commonly graded using the Gleason Score, which has been modified since its creation in the 1960s. A gleason score generally consists of at least two components - a primary grade and secondary grade, with an occasional tertiary grade. Namely, the primary grade refers to the most prevalent (>50% present) histological pattern, where the secondary grade refers to the second most prevalent (<50%, but >5%) pattern. These patterns are defined by the scoring system (see image), but only by visual identification contingent on qualitative criteria. The guidelines of this system, and many similar systems for other diseases, equip pathologists only with loosely standardized strategies, resulting in non-concordance in inter-pathologist diagnosis. In this particular example of prostate cancer grading, inter-pathologist concordance rates between individual diagnosis and retrospective expert consensus reviews are as low as 54.8%.

This is not unique to prostate cancer. For example, a 2015 publication in the Journal of the American Medical Association found that a group of pathologists agreed with an expert-consensus diagnosis of breast cancer slides only 75.3% of the time.

Pathologists agreed with an expert-consensus diagnosis of breast cancer slides only 75.3% of the time.
2.2 Standardization and the Struggle for Diagnostic Consensus (cont)

New biomarkers, stains, and imaging techniques have been developed as a means to improve the visualization of samples and reduce uncertainty in diagnosis. However, there is a dichotomy between the traditional “qualitative science” notion of pathology, which revolves around the analysis of histological patterns in H&E slides, and the introduction of new technologies, especially new molecular tests and visualization techniques, which offer the possibility for quantitative insight. These tests have added new complexities in the pathology workflow that many labs and their practicing pathologists are not well equipped to effectively handle, due largely to the time-intensive nature of both preparation and quantitative examination. Often, these methods, including many IHC stains, lend themselves to computer quantification, allowing the pathologist to spend time analyzing computer-extracted data rather than attempting to extract it themselves. However, computational techniques remain in infancy and have not yet been widely adopted in clinical settings due to a number of technological, financial, and regulatory barriers. Moreover, the scale of whole slide images often requires computing resources substantially beyond what most laboratories have provisioned.

<table>
<thead>
<tr>
<th>Cancer Type</th>
<th>Concordance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast (DCIS)</td>
<td>75%</td>
</tr>
<tr>
<td>Breast (Atypia)</td>
<td>48%</td>
</tr>
<tr>
<td>Prostate</td>
<td>54%</td>
</tr>
<tr>
<td>Lung (Stage IA)</td>
<td>68%</td>
</tr>
<tr>
<td>Lung (Stage IB)</td>
<td>54%</td>
</tr>
<tr>
<td>Lung (Stage II)</td>
<td>67%</td>
</tr>
</tbody>
</table>
2.3 Workflows are Diverse. Can One Size Fit All?

The pathology ecosystem is large and diverse, and features three main segments within the pathology space: clinical, research, and education. These subpopulations are enormously different with regards to what type of data is present, what technologies are currently available and attainable, available budgets, and their internal perceptions of their own needs.
2.3 Workflows are Diverse. Can One Size Fit All? (cont)

For clinical, these needs include:

- Data security and confidentiality (including HIPAA)
- Access to expert second-opinions
- Ability to perform consults
- Long-term storage and access
- Clinical workflow efficiency
- Tie-ins to a variety of patient data sources
- Reporting

For academic and pharmaceutical research, these needs include:

- Ability to mine metadata centrally
- Communication between partners and collaborators
- Creation of shared data collections
- Specific metric-gathering tools
- Access to customizable image analysis tools

For medical education, these needs include:

- “Ubiquitous” access
- Multi-platform capabilities
- Collaborative features
- Storage and retrieval
- Access privilege hierarchy

It’s important to note some of the commonalities between these segments. However, the challenge remains to address the entire subset of unmet needs in a digital pathology workspace while addressing segment-specific concerns.
2.4 The Capital Expense Burden

The cumbersome capital expenses inherent in large scale technology changes have slowed the adoption of digital pathology. Existing products such as server hardware, locally installed software, and medical equipment attempt to address the needs of the pathologists, but carry prohibitive upfront costs. In a 2012 survey by Laboratory Economics, over half of respondents indicated that digital pathology systems were too costly to implement. IT accounts for a substantial portion of capital expenses incurred by hospitals. According to an industry report provided by HIMSS Analytics, an average of 17.9% of all hospital capital expenses were IT capital expenses in the year 2011. Some of the more regularly associated costs of going digital include:

1. Scanners
2. IT Personnel
3. Installation fees
4. Servers
5. Processors
6. Networking Infrastructure
7. Monitors
8. Software licenses
9. Consulting fees
10. Software updates
11. Archived storage

The majority of these costs are capital expenses, the magnitude of which make switching towards digital pathology inherently costly and risky. To begin the transition to digital pathology, an institution must invest in slide-scanning hardware and corresponding servers to handle the new information. After the initial investment, the primary cost associated with these items relates to cost depreciation and maintenance costs incurred over the lifetime of the hardware. For example, the price range for scanner is between $100,000 and $150,000, if not more in some instances. Post-implementation costs are incurred as hospitals are required to pay for companion software and any relevant updates thereof. These include expensive software licenses, consulting fees, software updates, and the IT personnel who ensure proper implementation of these systems. These costs render installation of new systems and the expansion of existing ones challenging even for large institutions such as research hospitals or pharmaceutical companies.
3. The Solution: Taking Pathology to the Cloud

There has been tremendous growth in hospital infrastructure and pathology-oriented technology in the past decade, largely as a consequence of the adoption of whole-slide image scanners. These scanners allow the digitization of biopsy images and enable major changes to the existing clinical and research workflow. Hospitals, laboratories, and other organizations that have shifted to digital pathology systems have demonstrated increases in workflow efficiency, optimized their bottom-line, created new avenues for top-line growth, and ultimately impacted patient care. However, while scanners are an essential first step towards building out this new technological transition, the IT infrastructure required to support digitization is immensely underdeveloped.

The next step in the evolution of pathology is to bring it to the cloud.

Supporting a digitized pathology workflow with a cloud solution carries enormous benefits. It dramatically reduces capital investments, significantly reduces installation and update costs, provides a means to scale on-demand, and allows a lab to go global. The paradigm of cloud pathology is the epitome of a complete digital model for pathology systems.
3.1 Doing Cloud Right: Backbones, not Band-Aids

A cloud-based solution is just that — a solution, and not a product. The National Institute of Standards and Technology (NIST) defines cloud computing as:

“...a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.”

In the setting of digital pathology, for a solution to be cloud-based it should have a few key capabilities:

1. The solution should be able to scale to include multiple functionalities (image analysis, telepathology, etc.)

2. These vertical functionalities must operate with a central cloud infrastructure backbone (storage / computing). There may be various functional components that have specific uses, but each of these is linked via a central cloud platform, reducing the organizational work required by the pathologist and improving access to data.

3. Information must be securely accessible within the pathologist’s typical work environment.
3.1 Doing Cloud Right: Backbones, not Band-Aids (cont)

Many existing products consist of disjoint components, ignore some or most elements of pathology workflows, and integrate poorly with those workflows. Pathologists and hospital IT managers should be wary of the common inadequate solutions that are cloud in name only or incomplete fixes to the problems observed in non-cloud products:

“Band-aid solutions”

Patching on-premises technology shortcomings with remote access functionality.

Many companies offer remote hosting solutions to coexist with their software, simple web viewers to access slides from on-premises servers, or remote computing clusters to process high-volume batches of images for computational analysis. These may act as temporary fixes, but offer limited tool and application access on the cloud component.

“Non-hosting solutions”

No cloud-based storage or access of any sort.

These products would more appropriately be called applications or application groups, as they provide a level of functionality but require constant access to non-cloud elements. Examples of these products include image-processing packages that perform cloud-based computation on locally-stored images. When information is not cloud based, accessing it is disjointed and inefficient, and data sharing remains challenging.

“One-product solutions”

Provide one single cloud-delivered function and ignore the other elements of the workflow.

A one-product solution may include some level of cloud storage, but only do so as a part of the process of performing a single intended function. Stored data and information cannot be utilized for other functions. These solutions tend to create as many problems as they solve, as they require additional interoperability guarantees between discrete elements of the work process.
3.2 Capital Expense Burden: Eliminated

The cloud welcomes a new cost structure to hospital systems that turns the cumbersome upfront IT capital expenses into leaner operational costs. Pathology departments are currently limited by the substantial investments required to go digital. A cloud solution, however, provides a financially conservative, risk averse alternative to building out an on-premises infrastructure to support digitization.

### Legacy CAPEX vs. CLOUD CAPEX

<table>
<thead>
<tr>
<th>Legacy CAPEX</th>
<th>Cost</th>
<th>CLOUD CAPEX</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Scanners</td>
<td>150,000</td>
<td>1. Scanners</td>
<td>150,000</td>
</tr>
<tr>
<td>Reduced</td>
<td></td>
<td>Reduced</td>
<td></td>
</tr>
<tr>
<td>2. IT Personnel</td>
<td>25,000</td>
<td>2. Limited Personnel</td>
<td>5,000</td>
</tr>
<tr>
<td>Reduced</td>
<td></td>
<td>Reduced</td>
<td></td>
</tr>
<tr>
<td>3. Implementation Costs</td>
<td>70,000</td>
<td>3. Limited Installation Fees</td>
<td>10,000</td>
</tr>
<tr>
<td>Eliminated</td>
<td></td>
<td>Eliminated</td>
<td></td>
</tr>
<tr>
<td>4. Storage Servers</td>
<td>712,000</td>
<td>4. Monitors</td>
<td>10,000</td>
</tr>
<tr>
<td>Eliminated</td>
<td></td>
<td>Eliminated</td>
<td></td>
</tr>
<tr>
<td>5. Processors</td>
<td>12,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eliminated</td>
<td></td>
<td>Eliminated</td>
<td></td>
</tr>
<tr>
<td>6. Monitors†</td>
<td>10,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eliminated</td>
<td></td>
<td>Eliminated</td>
<td></td>
</tr>
<tr>
<td>7. Software Licenses†</td>
<td>30,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total $1,009,000**

**Total $175,000**

* Assuming 3 IT professionals (annual salary of $50,000) working for 2 months

** Per image cost of $4, with 178,000 image capacity (varies)

*** Assuming 3 additional servers (~$3,000 each) required to run software and serve images

† Cost Varies
3.2 Capital Expense Burden: Eliminated (cont)

The transfer from Capital Expenses to Operational Expenses via the cloud have the following outcomes:

- **Decreases burden on IT staff** With more computational and storage responsibilities being relocated to external providers, the responsibilities of the IT staff gradually shift from maintaining legacy systems to ensuring smooth integration with new digital systems and facilitating interconnectivity between domestic departments.

- **Reduced installation time** Setting up an on-premises digital pathology system often requires a 3rd party company to work with their client in setting up the IT infrastructure. This process can take weeks to months. While much of this work may be necessary, especially for enabling primary diagnosis, the time required to build the infrastructure on premises can be substantially reduced by shifting the burden to an off-premises infrastructure.

- **Eliminates the need for costly local IT infrastructure** Computational resources are adopted by specialized providers with remote servers and processors. Cloud providers in digital pathology can rapidly provision a private cloud for clients.

- **Flexible Software Pricing** A cloud-based solution can be priced using models based on actual usage evaluated periodically. Updates of cloud-based software typically require little to no installation and come at little to no extra cost.

- **Simplified Backup and Archiving** Rather than requiring active archiving by the hospital, a cloud-based solution can provide immediate, secure backup off-premises. Files can be maintained in various states of accessibility at very low costs compared to on-premises solutions.
3.3 Scale Computing Resources On-Demand

The immense amount of data going through a pathology workflow makes shifting to digital pathology paramount in many patient care systems. Evaluating biopsy samples, a fundamental element of pathology, entails digitally scanning tissue samples to create whole slide images varying size between 2.5 GB and roughly 10 GB per uncompressed image. A typical pathology lab can see as many as 1,000 images a day, accounting for as much as 10TB of information created daily at one single pathology institution. Demand variability throughout the course of a single day places additional strain on many pathology systems.

The dynamic construction of the cloud addresses both high volume levels and demand variability by automatically adjusting the amount of computational resources needed. Not only does having off-site storage and computation greatly increase the maximum available server capacity, but it also allows for on-demand requisitioning of the exact capacity needed. Transitioning to the cloud ensures that the user pays only for the amount of computing actually used. The cloud’s dynamic ability to scale on demand accounts for both long term savings on the server-installation front as well as efficiency improvements for daily usage.

![Capacity vs Utilization Curve](image-url)
3.4 With Cloud Comes Global Access

Perhaps the most efficacious method to negate the global pathology demand shortages discussed above is through effective collaboration. The cloud unlocks collaboration on two different levels: intra-institutional and inter-institutional. Intra-institutional connectivity includes the sharing and management of information within one organization, and can be both inter-departmental and intra-departmental. The intra-institutional connectivity enabled by the cloud also facilitates the transition of remote-site pathology workplaces towards a more centralized model of information management. Inter-connectivity describes pathologists working with peers from external organizations, including those across borders. The off-premises infrastructure that cloud-based digital pathology provides facilitates this mechanism of information sharing by reducing the logistical burden of collaboration between two institutions. The ability to outsource cases modifies the nature of diagnostic efforts from one that is entirely local to one that incorporates a global pathology network. Creating a global pathology ecosystem can help relieve pathologist supply deficits in developing countries around the world and merge collaborative efforts worldwide.

Likewise, as geographic borders are surpassed, so are barriers between industry segments. All segments of the pathology industry—the clinical, research, pharmaceutical, and academic—are interconnected and, in some cases, interdependent. Academic and pharmaceutical research frequently rely on clinical data for uses such as drug discovery, clinical trials, and development of companion diagnostics. Similarly, the academic education realm is constantly preparing the next generation of practicing pathologists and developing the next fundamental breakthroughs in the field at the benchside. Telepathology, a tangible result of a cloud-based infrastructure for pathology, facilitates synergy between these industry segments.
3.5 A New Solution for Adaptive Workflows

The global pathology ecosystem features diverse audiences that subsequently have many disparate needs (see section 2.3). In order to realize the highest level of efficiency, a digital solution must be tailorable to specific needs of each institution and user. This includes providing integration of the existing institution’s infrastructure, as well add-on tools, on a per-user basis. The two key elements of a cloud platform that enable a hospital to meet the individual demands of each user are interoperability and customizability.

**INTEROPERABILITY** Overhauling an existing infrastructure in the transition to digital pathology often introduces the concern that the new system will preclude the use of existing hardware and software. However, the dynamic structure of the cloud allows for the integration of third party software modules and hardware components. A common cloud platform provides hooks for any software or hardware, often with the additional ability for customized integration of internally-developed tools. Considering this configuration, cloud platforms are designed to smoothly integrate with other devices of any make and model on the same network, including whole slide image scanners, the most common hardware that must be completely functional in any digital pathology workflow. Likewise, a cloud platform contains the capacity to integrate with other softwares relevant to the digital pathology space. These include, but are not limited to: EHR compatibility, 3rd party software offerings, companion diagnostics, and healthcare workflow measurement software.

**CUSTOMIZABILITY** Customizable controls create the logistical opportunity for a user to control their interactions with the platform. Internally, institutions are able to delegate privacy and permissions settings to protect the integrity of the classified patient EHR via private institutional clouds. Each user or member of a predefined clearance level can be granted access not only to a unique subset of patient data, but also to the use of features and software components that integrate into the cloud workflow. Accesses can be changed rapidly, as can the set of tools available to each user. Additionally, within institutional networks, individual workflows can be measured and tracked, essentially creating an Enterprise Resource Planning (ERP) system designed for the pathology space. The result is a platform easily tailored to accommodate the distinct needs of the user.
Cloud enables this interoperability and customizability by providing a common platform from which each tool or process can be accessed without requiring the manual installation of each. Because the cloud is based on centralized servers, the customizable sets of tools are stored off-site, reducing IT expenditure and decreasing the time and effort required to install new programs on multiple workstations. Cloud-based models are uniquely appropriate to meet this demand for customizability.
4 Addressing Common Misconceptions

While there are clear advantages to shifting to a cloud based digital pathology solution, there are two notable hindrances that may temporarily slow its widespread adoption: Data security and Integration/installation. These two elements represent the barriers to the cloud pathology market that, although significant, can be overcome through strategic technical, regulatory, and security development. Many aspects of these issues have already, in fact, been addressed as cloud security has become an increasingly well-developed and well-regulated field. Regardless, an adopter of cloud-based pathology solutions must consider these concerns before implementing a cloud pathology system.
4.1 Cloud is Best (Yes, Best) for Data Security and Privacy

A significant concern regarding digital medicine is protecting patient privacy and ensuring data security. Cloud based technologies must be especially careful to protect users not only from outside parties, but also internal threats on the same platform. In addition to FDA guidance, HIPAA, HL7, and DICOM are the most relevant security protocols for cloud pathology data storage and image sharing. FDA regulations require well-tracked and well managed electronic records, as per Title 11 regulations. The Health Insurance Portability and Accountability Act of 1996 (HIPAA) established a set of national standards regarding the electronic health care transactions in the United States. Similarly, Health Level-7 (HL7) a set of international standards for transfer of clinical and administrative data between software applications used by various healthcare providers. Lastly, Digital Imaging and Communications in Medicine (DICOM) is a standard for handling, storing, printing, and transmitting information in medical imaging.

Unfortunately, a large amount of this guidance lists only system needs rather than providing a true pathway for building a secure digital solution. HIPAA compliance, while not overly challenging to guarantee, provides only a list of privacy needs, and not a how-to guide for ensuring the protection of private data. Health Level 7 documentation additionally provides some insight into more technical specification, but again fails to address how to implement a safe and secure cloud network. The burden, then, is on the solution provider to demonstrate adequate security and privacy protection to the decision makers at clinical institutions. Further security assurance from outside organizations that specialize in data protection is often required to assuage the justifiable hesitancy of hospital CIOs to adopt a largely digital infrastructure.

While security and privacy are valid concerns, 94% of managers say their business security has improved since they started using cloud services and 91% of business owners say that cloud service suppliers make it easier to satisfy compliance requirements. This may be due to the improved ability of cloud-based solutions to provide security by reducing the number of components involved in a system. It also may be due to the centrality of servers, which enables the solutions provider to protect data in bulk, for many clients at once. Regardless, the industry recognizes, and is working towards providing market confidence in data security and privacy.

While security and privacy are valid concerns, 94% of managers say their business security has improved since they started using cloud services and 91% of business owners say that cloud service suppliers make it easier to satisfy compliance requirements.
A potential hindrance in the adoption of cloud-based digital pathology is concern regarding integration of the system with existing solutions and workflows. As with any new implementation of technology, initial integration costs are incurred, especially when installing capital assets. The traditional hospital IT infrastructure integration process involves burdensome capital expenses depending on the size of the system. These expenses are generally realized in an upfront manner.

However, the transition from IT hardware to cloud computing and storage converts capital expenses to operating expenses and eliminates installation overhead.

The most notable difference between the two cost structures is the method in which costs are generated. Capital expenses are typically larger and invested before usage to provide the resources for future usage whereas operating costs are accumulated based on usage amounts incurred over a past period. Institutions also incur depreciation expenses as the value of capital assets, including IT infrastructure, decreases constantly. Implementation costs of cloud services are not negligible, but significant savings are captured when switching away from traditional IT infrastructure, and these savings accumulate with elapsed time. Cloud service clients only pay for the services they use and have reported savings of 50-75% of total cost of ownership.

Ultimately, a hospital CIO determining whether or not to adopt a cloud-based digital pathology system must estimate the future operating expenses associated with a demand-based model and determine any cost savings or losses. Although the aggregated operating expenses of a cloud-based system are less than the upfront capital expense of traditional non-digital systems, this predictive element may prove to be a potential hindrance to clients in this risk-averse space. By demonstrating manageable short term operating expenses in a cloud-platform, solutions providers may be able to assuage this concern. However, alleviating this uncertainty requires an intense retrospective evaluation of recent and historical usage data and projecting potential unrealized cost savings on a recent and future operating expenses-based mode.
5. The Cloud Prognosis: What the Future Holds

There is a clear need for a solution to the growing burdens facing pathology. The deficit in the number of pathologists in the workforce, in combination with the inherently diverse, time-consuming, and often subjective nature of the work involved in making diagnoses, necessitates a major paradigm shift in how pathology functions. A cloud based approach is an ideal solution that meets the needs of the current pathology crisis without increasing the capital and infrastructure burden on hospital systems. Implementation of a system is not only feasible, but is, in fact, a cost-effective, secure, and efficient way of changing workflows to meet increasing demand. As cloud-based digital pathology works through regulatory and implementation concerns with increasing success, cloud-based digital pathology has shifted from an idea to a realizable solution. The question has therefore become: what’s next?

Digital pathology is experiencing a period of rapid expansion driven by the recent adoption of whole slide image scanners in medical institutions. As a result, the digital pathology industry that was valued at $248.4MM in 2013 is projected to exceed $692.5MM in value by 2022, with a CAGR of 12% over that period. However, the first lab in the entire world to transition to completely digital diagnosis did so only as recently as June of 2015. With other labs across the world eventually following suit as technology improves and confidence in cloud solutions rise, the subindustry of digital pathology has the potential to be present in every clinical hospital worldwide. Further, growth is expected to be driven by increasing prevalence of cancer and other tissue-based diseases. According to the World Health Organization, the number of cancer diagnoses is expected to increase by 70% in the next two decades globally, with an estimated 1.41 million instances of misdiagnosis. Technologies such as the cloud, EHR, and digital health workflows are playing an increasingly important role in combating this rise. The pathology industry is clearly seeing a drastic increase in demand and a clear necessity to go digital.

The dream is to enable efficient and seamless integration of all elements of the pathology lab into one smooth workflow. Taking this vision a step further, the true goal of cloud-based solutions is not only to create internal connections within the target field of pathology, but to create a fully integrated clinical solution that ties in all relevant fields of medicine. With the almost ubiquitous adoption of EHRs as the backbone of hospital information infrastructure, the stage has been set for inter-department connectivity. Cloud-based solutions in radiology have already been validated as a uniquely apt means of generating a functional system for information and data collection and exchange. However, cloud-based digital pathology is a couple of years behind the more established
5. The Cloud Prognosis: What the Future Holds (cont)

cloud-based digital radiology field, and must grow before it can fully realize this vision.

Cloud-based digital pathology as it currently stands has a tremendous amount to offer clinicians, hospital CIOs, and patients. The cloud enables powerful telepathology capabilities that provide clinicians and experts the opportunity to collaborate with colleagues across the world, to contribute to decreasing the burden on the workforce, and to deliver greater quality of care universally. It can be a platform for distributing quantitative tools both for research, and ultimately in clinical settings. The adoption of cloud-based solutions has created an efficient and meaningful digital pathology paradigm that no other approach has been able replicate.
Citations


MEDICINE IS CHANGING

Proscia solutions can take you where medicine is going, connecting pathology, accelerating discovery, and transforming organizations that make a difference.

To learn more about what Proscia can do for you, get in touch at:

info@proscia.com    |    www.proscia.com