



Going Digital in Renal Pathology: Providence Health Care's CaloPix® Pilot

Executive Summary

Providence Health Care (PHC), one of British Columbia's leading academic institutions, launched a forward-thinking pilot initiative to evaluate the feasibility of digital pathology in renal diagnostics—an area known for its diagnostic complexity and clinical sensitivity. Conducted under the Provincial Laboratory Medicine Services (PLMS) Digital Pathology Test Bed, the pilot tested whether digital slide review could match the accuracy and reliability of traditional glass microscopy.

The renal pathologists achieved $\geq 95\%$ concordance of digital diagnosis with glass slide diagnoses across ten of thirteen renal pathology metrics, including up to 100% concordance in critical parameters such as presence of cortex and fibrinoid necrosis.

While multiple digital pathology platforms were assessed in the pilot, CaloPix® stood out for its intuitive design, robust functionality, and strong clinical performance. CaloPix® was noted to have easy slide navigation, the largest side-by-side stain viewing capacity, and optimized streamlined workflows. PHC's private and secure Microsoft Azure cloud deployment also marked a provincial first, confirming that secure, scalable, cloud-based digital pathology is both feasible and beneficial.

This pilot illustrates that digital pathology is not just viable—it's valuable. The CaloPix® deployment enhanced diagnostic consistency, improved user experience, and created new opportunities for enterprise-level integration, including AI. It also revealed key best practices for institutions preparing for digital transformation, from ergonomic upgrades to LIS integration and cross-departmental alignment.

PHC's experience offers a practical roadmap for other healthcare organizations ready to modernize pathology. Digital pathology is no longer just about replacing glass—it's about rethinking how diagnoses are delivered.

Introduction

Providence Health Care (PHC), one of British Columbia's foremost academic and clinical institutions, launched a pilot to evaluate the feasibility of digital pathology for medical renal biopsy diagnostics—one of the most complex areas in pathology. Conducted as part of the Provincial Laboratory Medicine Services (PLMS) Digital Pathology Test Bed, the objectives of the project were two-fold: 1. perform highly detailed comparison of digital versus slide review of key morphologic findings that go beyond simple final diagnosis and 2. develop a cloud-based digital infrastructure that would allow for independence in the PHC system but also be fully compatible with the provincial digital architecture to support province-wide compatibility and collaboration.

Laboratory medicine in British Columbia functions in six independent health authorities, where each health authority oversees and manages laboratory operations at local hospital sites within the health authority but under the administrative oversight of PLMS and Ministry of Health. This allows each health authority to meet local needs while operating under a larger, provincial architectural framework. This operational organization was further developed to include digital pathology by PLMS.

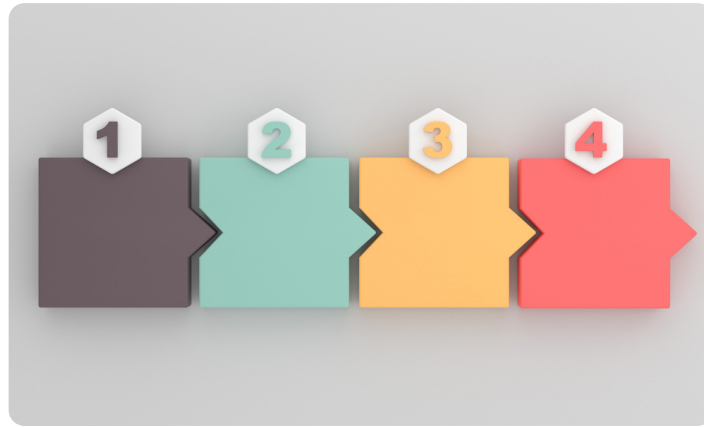


As part of this provincial initiative, PHC evaluated several digital pathology software platforms, including CaloPix®, that were deployed within the local PHC cloud-based digital infrastructure. This deployment for local use within the cloud that also enabled vendor agnostic collaboration under the provincial cloud architecture represents a first-in-kind approach to digital pathology infrastructure and operational organization unique to British Columbia. No formal vendor was selected by PHC, but in collaboration with Tribun Health, CaloPix® was essential to fully develop the cloud infrastructure and was deployed for St. Paul's Laboratory use in the clinical digital validation. Tribun Health's commitment to flexibility to meet PHC's clinical needs and responsiveness to technical and pathologist feedback were pivotal in the advancement of the PHC local renal pathology pilot, which in turn contributed to the larger provincial test bed.

Project Design and Clinical Scope

Objective:

Diagnoses made by reviewing digital images must be demonstrated to be equivalent to diagnoses made by reviewing conventional glass slides with a microscope. Traditional validation of digital pathology has been accomplished by comparing diagnostic concordance between these two modalities. Medical renal biopsies are highly complex specimens that require evaluation by multiple forms of microscopy, not just light microscopy. To mitigate diagnostic difficulties with light microscopy only, 13 biopsy pattern metrics usually included in the microscopic descriptions of the renal pathology final reports were evaluated and compared in addition to the final diagnosis pattern. These metrics were unanimously agreed upon by the renal pathologists to be important for medical renal pathology reports.



Methodology:

Sixty renal pathology cases—26 retrospective and 34 prospective—were selected for review. Each case was examined independently by a pathologist using both glass and digital modalities, separated by a two-week washout period to reduce recall bias. Light microscopy was the exclusive focus, providing a controlled and challenging test of digital capabilities in isolation from IF and EM.

Data Collected:

- 13 medical renal biopsy pattern metrics for comparative analysis
- Pathologist-reported feedback on usability, efficiency, software features, and digital pathology experience

This approach allowed for a rigorous clinical assessment while capturing the daily user experience—critical for sustainable implementation.

Quantitative Results: Diagnostic Concordance

Digital vs. Glass Slide Review:

In the initial analysis, digital results were compared to traditional glass slide review using strict criteria: any discrepancy or unanswered metric was marked as discordant.

Metric	Percent Digital Concordance with Glass
Number Renal Fragments	93%
Cortex Present	100%
Medulla Present	90%
Other Tissue	75%
Glomerular Pattern	93%
Crescents Present	98%
Fibrinoid Necrosis Present	100%
Tubulitis Extent	88%
Interstitial Inflammation Extent	88%
Interstitial Fibrosis and Tubular Atrophy Extent	87%
Intimal Fibrosis Extent	87%
Arteriolar Hyalinosis Extent	92%
Diagnosis Pattern	90%

Key Takeaway:

Only 3 metrics met the recommended 95% concordance in CAP guidelines. This is most likely due to adhere to strict criteria when there is well-known intra- and inter-pathologist variability in renal pathology glass slide review.

Digital vs. Final Signed Report:

To better determine clinical alignment, a second analysis compared digital reads directly with the final pathology report—the clinical gold standard that interprets biopsy findings in the context of clinical history and patient test results, which were not provided in this pilot. Unanswered digital metrics were excluded from this analysis.

Metric	Percent Digital Concordance with Final Report
Number Renal Fragments	100%
Cortex Present	100%
Medulla Present	97%
Other Tissue	100%
Glomerular Pattern	95%
Crescents Present	98%
Fibrinoid Necrosis Present	100%
Tubulitis Extent	95%
Interstitial Inflammation Extent	88%
Interstitial Fibrosis and Tubular Atrophy Extent	95%
Intimal Fibrosis Extent	90%
Arteriolar Hyalinosis Extent	93%
Diagnosis Pattern	98%

Key Takeaway:

10 of 13 metrics reached or exceeded **95% concordance**, including **diagnosis pattern (98%)**, **tubulitis (95%)**, and **interstitial fibrosis and tubular atrophy (95%)**, which is an important prognostic indicator of long-term kidney outcomes. Notably, digital interpretation of **interstitial fibrosis and atrophy** aligned more closely with the final report than glass review. Quantitation of interstitial fibrosis and tubular atrophy, interstitial inflammation, intimal fibrosis, and arteriolar hyalinosis are all metrics that are well-known in renal pathology to be inconsistent not only among renal pathologists but also for the same renal pathologist at different times. The quantitative findings confirm that digital pathology is a reliable platform in medical renal diagnostics, and all software including CaloPix®, performed with a high concordance rate.

Qualitative Feedback: Pathologist Experience

Digital pathology is completely different from conventional glass slide pathology, not only because of the method of image review (digital image versus stained tissue on glass slides) but also in the equipment used. With this marked difference in day-to-day workflow, the pathologists' qualitative experience was also captured, and their feedback was used to adjust and enhance CaloPix® deployment to further improve the pathologists' experience.

What Worked Well:

PHC Pathologists reported that digital pathology—when supported by the right software—offers tangible workflow improvements over conventional glass slide review.

Key CaloPix® Benefits Reported:

- **Streamlined slide navigation:** No manual refocusing; seamless zooming and panning at various magnifications.
- **Improved workflow efficiency:** All digital slides were accessible in one interface, eliminating physical handling and risk of loss or breakage.
- **Enhanced comparative diagnostics:** Side-by-side viewing of stains and historical biopsies made tracking progression of findings within a biopsy sample and changes to patient biopsies over time faster and more precise.



- **Image quality and fidelity:** High-resolution images with contrast and colour adjustments helped mitigate stain variability.
- **Comprehensive annotations:** Users appreciated the ability to add detailed, measurable notes directly onto the image. This also improved pathologist to pathologist communication regarding biopsy findings.
- **Better organization for consults and multidisciplinary rounds:** Easier case preparation and remote collaboration, thanks to centralized archives and clearer visuals.

Areas for Improvement:

- **Fixed focal plane:** At higher magnifications (40x and 60x), the inability to refocus post-scan was a significant limitation, especially for fine diagnostic tasks.
- **Loss of tactile workflow cues:** The absence of physical microscope controls meant pathologists had to adapt to new visual and operational routines.
- **Digital fatigue:** Extended sessions introduced strain from screen use and mouse movements. Users noted a need for improved workstation setups (e.g., 3D mice, larger monitors, ergonomic chairs) which were not available during POC.
- **Learning curve:** Despite the intuitive interface of programs like CaloPix®, digital navigation still slowed down initial reads due to the lack of ingrained “muscle memory” from years of microscope use. From other sites that have gone digital, this learning curve is short.
- **No LIS integration:** The inability to sign out cases or access full clinical context within the same system was a workflow barrier—and will need to be addressed for full operational deployment. It was out of scope for the POC.

Digital pathology is not a one-to-one replacement for the microscope—it’s a reimagining of how diagnostics are done. The transition introduces a different rhythm and set of tools. What matters most is not just the software, but how well it integrates into the working lives of the pathologists. With proper training, ergonomic improvements, and LIS integration, digital pathology can evolve from a promising pilot into a transformative everyday tool

Viewer Performance and Preferred Features

As part of the pilot, PHC evaluated several digital pathology platforms, including CaloPix®, to determine what general features best met the needs of renal pathologists.

CaloPix® Features Highlighted by Pathologists included:

- Fast, responsive interface with minimal lag
- High-resolution image rendering
- Powerful comparison tools with locked panes that move all sections in unison
- Easy annotation and case sharing
- Excellent vendor support

No vendor was formally chosen in this pilot, but the responsiveness of Tribun Health to user feedback and Tribun Health’s flexibility and willingness to meet technical requirements for cloud development and software maintenance were essential for the success of the pilot project.

Best Practices for Broader Deployment

1

Ergonomics Matter: Equip teams with high-resolution monitors, 3D mice, and adjustable workspaces.

2

Integrate with LIS Early: Real gains happen when systems talk to each other.

3

Train with Purpose: Use pilot cases as onboarding tools and hold real-time demo sessions.

4

Avoid the Hybrid Trap: A full shift to digital removes the friction of toggling between formats.

5

Make the Case for AI: Start exploring quantification tools now—even if it's just for fibrosis or inflammation scoring.

6

Think Enterprise-Wide: Share results beyond the pathology department. Radiology, oncology, and surgery will benefit.



IT Perspective: Infrastructure and Security

The successful deployment of CaloPix® at St. Paul's Hospital cloud infrastructure was more than a technical exercise—it was a real-world validation of what it takes to deliver secure, scalable, cloud-based digital pathology in a clinical environment. As part of the PLMS Digital Pathology Test Bed, this project marked the first provincial use of cloud-hosted infrastructure for clinical digital pathology and offered key lessons and breakthroughs across infrastructure, security, and governance.

Cloud-Based Architecture: Laying the Foundation

The platform was deployed in a private and secure Microsoft Azure cloud environment integrated with the hospital network and managed by PHSA. This environment enabled clinical-grade performance while complying with provincial healthcare data standards and meet enterprise security requirements.



Key Advantages Included:

- Secure, high-capacity storage for cost-effective storage of large volumes of high-resolution whole-slide images
- Fast, remote access for pathologists working across different locations
- Streamlined software maintenance, with updates managed centrally in the cloud
- Elastic infrastructure, adaptable to future scale-up and multi-site expansion
- Workflow orchestration, allowing efficient data ingestion and multi-source integration

This pilot established a blueprint for future cloud deployments across British Columbia's health network, proving that cloud isn't just feasible—it's advantageous when managed within a strong governance framework.

Privacy and Cybersecurity:

Cybersecurity and data privacy were treated as core pillars of the deployment—not afterthoughts. The process uncovered just how essential early and continuous security alignment is for health IT innovation.

Key Actions Taken

- **Privacy Impact Assessment (PIA):** A full PIA was conducted to evaluate risks and devise mitigation plans. This uncovered actionable gaps that were addressed before the system moved into production.
- **Security & Risk Audits:** Multiple security reviews and audits were performed, including endpoint hardening, role-based access controls, and network vulnerability checks.
- **Stakeholder Engagement:** IT, cybersecurity, and vendor teams (Tribun Health) worked in close coordination, fostering transparency and accountability across all parties.
- **Timeline Impacts:** Security processes—particularly the PIA and remediation efforts—were the primary contributors to project timeline. The lesson is clear: initiate compliance processes early and build time buffers for approvals.



Workflow Innovation: Optimizing for Clinical Efficiency

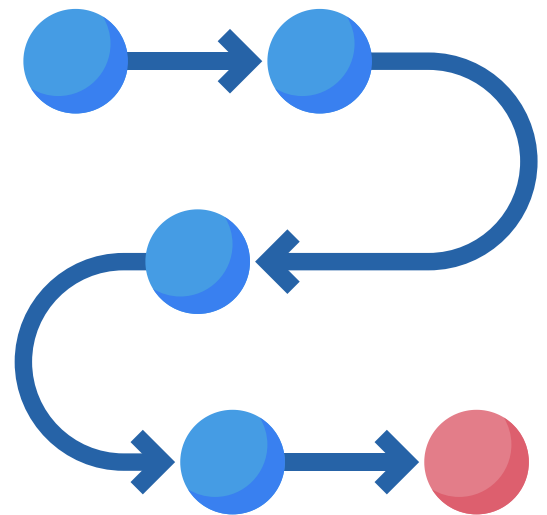
Beyond infrastructure, the project served as a testing ground for future-ready digital pathology workflows. Collaborative working sessions between PHSA IT, St. Paul's, and Tribun Health explored ways to:

- Improve data ingestion processes
- Reduce system dependencies and bottlenecks
- Leverage cloud-native capabilities for real-time processing and archival
- Plan for LIS integration, ensuring continuity from image acquisition to case sign-out

These forward-looking discussions laid the groundwork for broader digital transformation in pathology services.

Key Takeaways

- **Security Must Lead:** Privacy and cybersecurity processes should begin at project inception. They are critical to trust, compliance, and clinical approval.
- **Cloud Is Clinical-Grade:** When governed appropriately, cloud-hosted environments can meet the stringent performance and security needs of healthcare.
- **Integration Matters:** LIS and hospital IT integration must be planned early to prevent workflow silos and data fragmentation.
- **Collaboration Is Non-Negotiable:** Success was driven by tight coordination between clinical teams, IT, cybersecurity, and software partners.
- **Innovation Pays Off:** Exploring infrastructure and workflow optimizations—even in a pilot phase—sets a strong foundation for scalable, enterprise-grade deployments.



Digital pathology is more than software—it's a system of people, processes, and technology. Getting the IT foundation right is the first step in making the transformation real, sustainable, and secure.

Summary

In the modern era of medicine, speed and accuracy are critical. The Providence Health Care collaboration with Tribun Health showed that digital pathology is no longer a futuristic concept; it's a current-day solution ready to solve real-world problems.

This pilot demonstrates the value of going digital isn't just theoretical—it's measurable. From diagnostic confidence to workflow improvements, CaloPix® helped validate a new path forward for pathology at St. Paul's Hospital and, hopefully, beyond.

