AI-Powered Urine Cytology: Redefining Diagnostic Precision and Workflow at PathNet

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Executive Summary

In the rapidly evolving landscape of digital pathology, integrating Artificial Intelligence (AI) is a clinical necessity for high-volume laboratories. **PathNet**, a fully digital laboratory in Little Rock, Arkansas, processes over **16,000 urine cytologies annually**. By embedding the **AIxURO** algorithm directly into the **Lumea BxLink Platform**, PathNet has helped improve diagnostic consistency and workflow efficiency while prioritizing staff ergonomics.

The Digital Imperative: Human Intelligence Augmented by Precision

Pathology is undergoing a profound digital transformation. Traditionally, urine cytology has been a labor-intensive, manual process prone to fatigue and subjective variability. PathNet recognized that the true potential of AI lies in its ability to **enhance**, rather than replace, the expertise of cytologists and pathologists.

The PathNet Digital Ecosystem

PathNet's journey toward diagnostic excellence is built on a foundation of integrated technologies:

- **Lumea BxLink Platform:** A comprehensive hub for case management, image viewing, and reporting.
- **Leica GT450 Scanners:** High-throughput imaging that ensures specimens are captured in detail.
- **AIxURO AI Algorithm:** A robust tool designed to identify atypical and suspicious cells in liquid-based preparations.

Validation Process: Ensuring Diagnostic Accuracy

To maintain the highest standards of patient care, PathNet implemented a meticulous, three-phase adoption cycle to validate AIxURO's performance:

- **Discovery & Pilot Phase (Phase 1)**: The process began with a 10-slide demo to familiarize the team with the gallery-based interface and verify the algorithm's

ability to recognize suspicious and atypical cells based on quantitative and qualitative statistics.

- **Evaluation (Phase 2)**: This expanded into a 100-slide test where cytologists and pathologists compared live glass readings directly against AI-analyzed digital images.
- **Final Validation (Phase 3)**: A large-scale, **600-slide validation study** was conducted, which confirmed a **95% concordance rate** between traditional manual reviews and the AI-assisted system. Full integration was successfully achieved in December 2025.

Revised Digital Workflow: A Shift from Glass to Dashboard

The adoption of AI redefined the traditional roles within the laboratory, turning a linear, manual process into a collaborative, digital-first operation:

- **Preparation & Scanning**: Slides are prepared using the **ThinPrep** method and enhanced with a Lumea FocalRing®, which ensures the **Leica GT450** scanners maintain a precise focal plane for optimal digitization.
- **AI Pre-Screening**: The **AIxURO** algorithm immediately scans the digital images, subcategorizing cells into suspicious or atypical categories based on **The Paris System (TPS)**.
- **Cytologist Triage**: Instead of spending hours at a microscope manually "dotting" glass slides with ink, cytologists now review an AI-generated gallery of abnormal cells. They flag high-priority findings digitally, streamlining the hand-off to the pathologist. The glass slide is always available for review.
- **Final Pathologist Review**: Pathologists review the gallery of suspicious and atypical cells, and specific cells flagged by both the AI and the cytologists, allowing them to issue final diagnostic reports with significantly reduced review time.

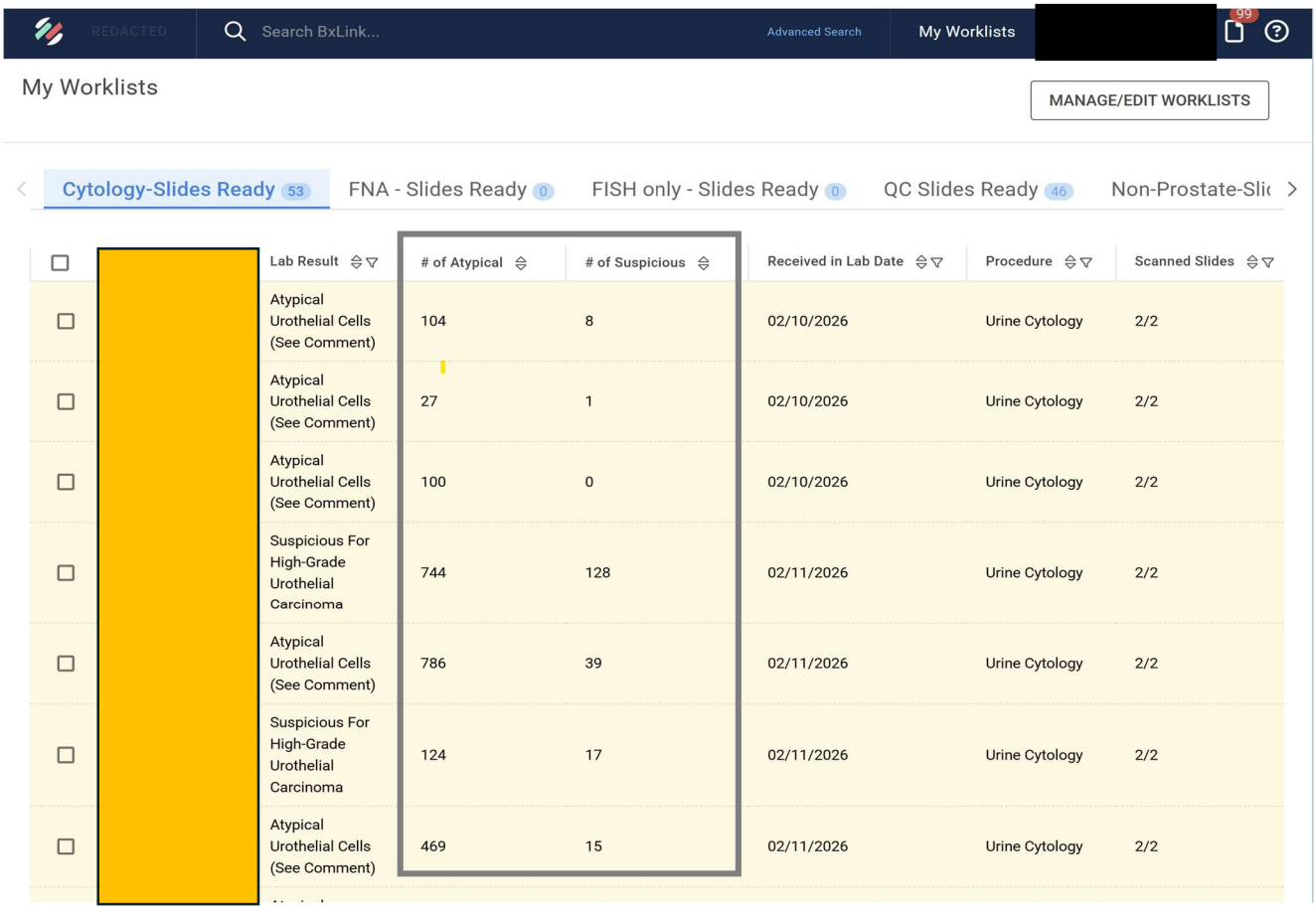
Leica GT450 Scanned ThinPrep slide with the Lumea FocalRing®

The Integrated Workflow: A Collaborative Approach

The integration of AIxURO™ data directly into the Lumea BxLink workflow has transformed the pathologist's daily operations by enabling data-driven case prioritization and streamlined reporting. By automatically flowing cell counts back into the Lumea BxLink system, the pathologist’s worklist now displays the specific number of atypical and suspicious cells identified by the AI for each case. This allows pathologists to immediately identify and prioritize high-risk or complex cases, ensuring that critical diagnoses are addressed with greater urgency and efficiency.

On the individual Diagnosis page, the seamless data flow provides several key advantages:

- **Statistical Snapshots**: Pathologists have immediate access to a "snapshot" of the AIxURO™ analysis, including the exact number of suspicious and atypical cells, which provides a quantitative baseline before the slide is even opened.
- **Integrated Reporting**: Bookmarked cells of interest and specific findings identified during the cytologist's primary screen flow back into BxLink. These high-quality digital images can be easily selected and embedded directly into the final pathology report, enhancing the clarity of the diagnostic findings for the referring clinician.

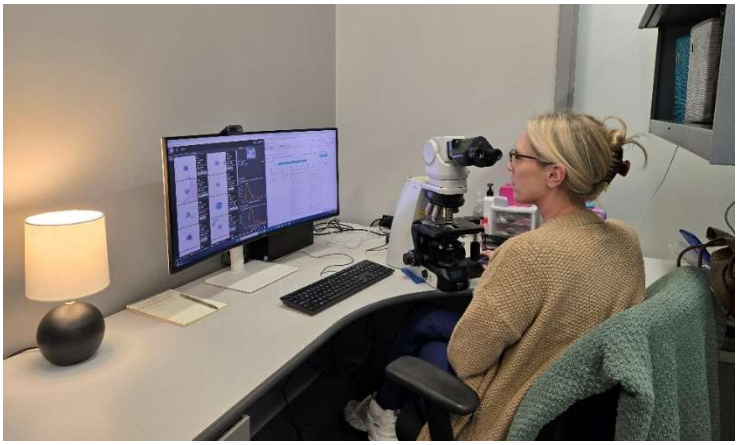


	[redacted]	Lab Result	# of Atypical	# of Suspicious	Received in Lab Date	Procedure	Scanned Slides
☐		Atypical Urothelial Cells (See Comment)	104	8	02/10/2026	Urine Cytology	2/2
☐		Atypical Urothelial Cells (See Comment)	27	1	02/10/2026	Urine Cytology	2/2
☐		Atypical Urothelial Cells (See Comment)	100	0	02/10/2026	Urine Cytology	2/2
☐		Suspicious For High-Grade Urothelial Carcinoma	744	128	02/11/2026	Urine Cytology	2/2
☐		Atypical Urothelial Cells (See Comment)	786	39	02/11/2026	Urine Cytology	2/2
☐		Suspicious For High-Grade Urothelial Carcinoma	124	17	02/11/2026	Urine Cytology	2/2
☐		Atypical Urothelial Cells (See Comment)	469	15	02/11/2026	Urine Cytology	2/2

Direct Feedback: The Cytologist Perspective

The feedback from PathNet's cytologists has been overwhelmingly positive, highlighting how the tool transforms their daily experience rather than eliminating their role:

- **Ease of Use:** Staff praised the user-friendly interface and the transition from ink-dotting glass slides to digital flagging.
- **Ergonomic Relief:** A significant benefit was the physical relief from continuous microscope use, which reduced physical strain and eye fatigue.
- **Increased Efficiency:** The AI was found to be particularly effective at accelerating the review of "scantly cellular" specimens and confirming negative cases, allowing staff to manage high volumes with greater ease.
- **Statistical Support:** Cytologists valued having quantitative statistics (such as nuclear area measurements) to support their morphological observations.



The PathNet Advantage

The implementation of **AIxURO™** at PathNet has delivered a comprehensive set of clinical and operational advantages by bridging the gap between digital pathology and automated analytical software. By integrating this tool into the daily workflow, the laboratory realized several key benefits:

Strategic Clinical Uses

- **Cyto-Histo Correlation:** The platform serves as a powerful additional tool for correlating cytology findings with surgical pathology results.
- **Quality Control Review:** AIxURO™ provides a robust QC layer, acting as a tireless "second set of eyes" to confirm results and reduce human fatigue.
- **Educational Advancement:** The digitized data and statistical analysis offer a modernized platform for the training and education of cytologists, residents and fellows.

Operational and Patient Benefits

- **Cost-Effectiveness:** Patients benefit from a reduction in unnecessary and expensive ancillary testing, such as UroVysion FISH, as the AI's precision assists in increased diagnostic confidence.
- **Workflow Efficiency:** The laboratory observed an increase in both cytologist and pathologist efficiency, particularly through the use of superior digital imaging.
- **Ergonomics and Reliability:** Beyond technical accuracy, the transition to digital analysis improved the physical ergonomics for cytologists and ensured the consistent confirmation of negative cases.

Conclusion: Setting a New Standard

PathNet's success proves that the future of pathology lies in the synergy between human expertise and machine learning. By embedding AI within the existing digital workflow, PathNet has empowered its staff to work more efficiently and comfortably while setting a new global standard for patient care.

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