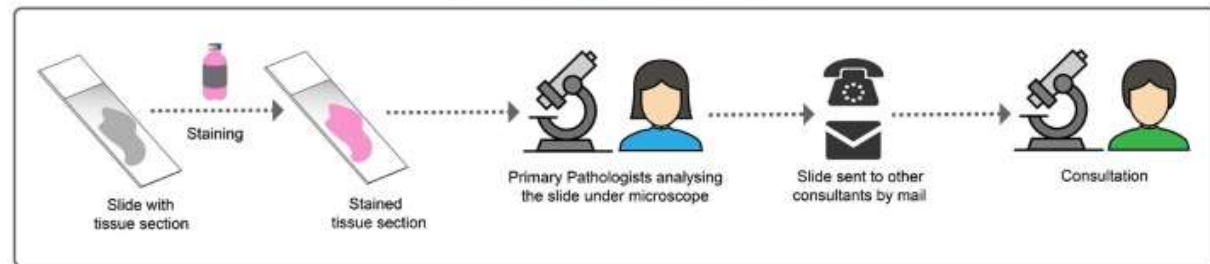


DIGITAL PATHOLOGY AND ARTIFICIAL INTELLIGENCE

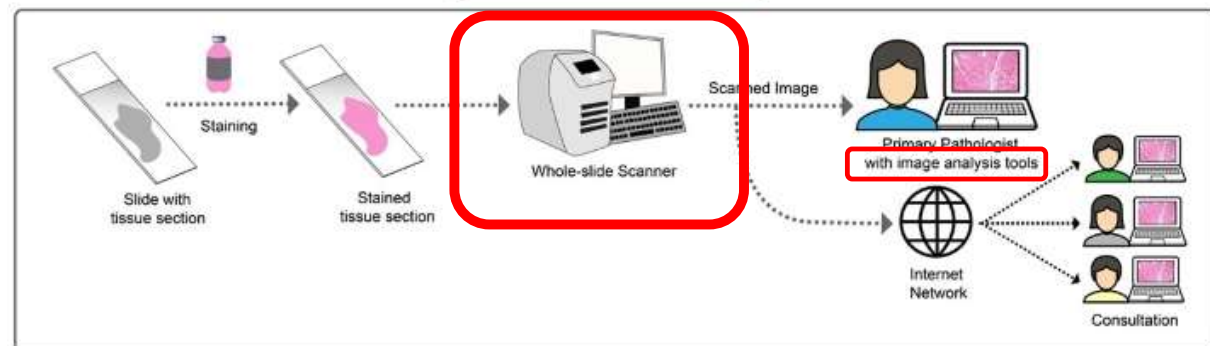
Lik Hang Lee
Anatomical Pathology – St. Paul's Hospital

WHAT IS DIGITAL PATHOLOGY?

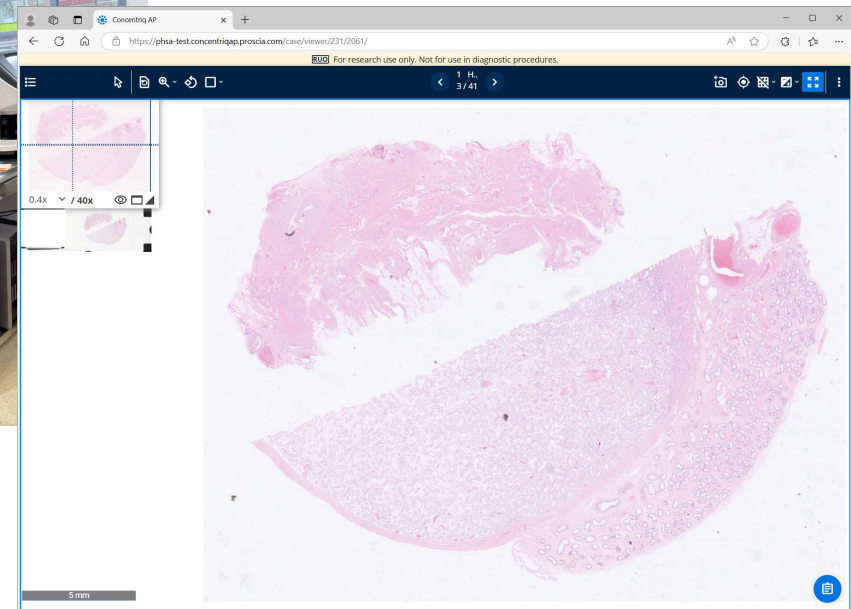
Traditional Pathology



Digital Pathology



WHAT IS DIGITAL PATHOLOGY?



BC'S JOURNEY

Mar 2022 – April 2023

- Provincial engagement
- MoH, PLMS and Laboratory Advisory Committee to develop the business case for AP digital services

2017 - 2022

- AP Advisory Group identifies Digital Pathology as a key strategy
- Initial market research

May 2023 – Dec 2023

- MOU between MOH, PLMS, and HAs
- Provincial Digital Pathology Working Group & Pilot Project Framework
- Created Provincial Digital Pathology Reference Architecture

Jan 2024 – March 2025

- Innovate BC funding committed, ending March 31, 2025
- **Pilot Projects** to test and de-risk the end-to-end reference architecture

Future Activities/Planning

- Business case for provincial scale up
- Examine funding models and opportunities
- Assess needs and evolution of AI, technology and quality practices



Provincial digital pathology cloud and provincial image management software allowing easy access to images, integration, collaboration and scalability



Pathology set up in **rural and remote** settings, **telepathology** capabilities with BC Cancer and **integration** with laboratory information system



Pathology within a highly specialized **cancer reference laboratory** and digital workflow for providing specialty consultation



Pathology within a **subspecialty of renal pathology** and leveraging advancements in the cloud to advance a provincial solution



Integration of **AI algorithms** into the digital pathology workflow to enable process automation and efficiency gains



Scalability and end-to-end digital pathology set up following lessons learned to-date, as well as **site-to-site** remote software



WHAT ABOUT IMAGE ANALYSIS?

5

> Methods Inf Med. 1965 Dec;4(4):163-7.

Morphological analysis of cells and chromosomes by digital computer

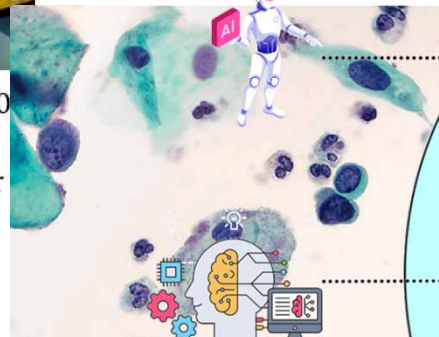
M L Mendelsohn, W A Kolman, B Perry

PMID: 21748889



Thinprep imaging system 2000

Calculation based on nuclear size and stain intensity.



Machine Learning

Artificial Intelligence:

Mimicking the intelligence or behavioural pattern of humans or any other living entity.

Machine Learning:

A technique by which a computer can "learn" from data, without using a complex set of different rules. This approach is mainly based on training a model from datasets.

Deep Learning:

A technique to perform machine learning inspired by our brain's own network of neurons.



WHAT CAN ARTIFICIAL INTELLIGENCE DO IN PATHOLOGY?



Increased accuracy



Improve Workflow/TAT



Discovery

INCREASE ACCURACY

- Detect suspicious/abnormal areas (“diagnostic aid” or “second read”).
- Detect minimal disease (micromets, microinvasion, etc.).
- Classify lesions (histologic subtype, grade, etc.)
- Quantify markers (tumor markers., PD-L1, HER2., mitotic counts.)
- Standardize (Ki67, PD-L1, minimize interobserver variability, improve consistency)

Pantanowitz et al. *Diagnostic Pathology* (2020) 15:80
<https://doi.org/10.1186/s13000-020-00995-z>

Diagnostic Pathology

RESEARCH

Open Access

Accuracy and efficiency of an artificial intelligence tool when counting breast mitoses

Liron Pantanowitz^{1,2*}, Douglas Hartman¹, Yan Qi³, Eun Yoon Cho⁴, Beomseok Suh⁵, Kyunghyun Paeng⁵, Rajiv Dhir¹, Pamela Michelow⁶, Scott Hazelhurst⁶, Sang Yong Song^{4†} and Soo Youn Cho^{4†}

Computational pathology in the identification of HER2-low breast cancer: Opportunities and challenges

Marie Brevet^a, Zaibo Li^{b,*}, Anil Parwani^b

^a *CyPath-RB, Lyon, France*

^b *Department of Pathology, The Ohio State University, Columbus, OH, USA*

npj | breast cancer

www.nature.com/npjbcancer

ARTICLE OPEN

Check for updates

Validation and real-world clinical application of an artificial intelligence algorithm for breast cancer detection in biopsies

Judith Sa
Anat Albi
Manuela

ORIGINAL ARTICLES

Artificial Intelligence Helps Pathologists Increase Diagnostic Accuracy and Efficiency in the Detection of Breast Cancer Lymph Node Metastases

Retamero, Juan Antonio MD, MSc[‡]; Gulturk, Emre MSc[‡]; Bozkurt, Alican MSc[‡]; Liu, Sandy MD[‡]; Gorgan, Maria MD[‡]; Moral, Luis MD[‡]; Horton, Margaret PhD[‡]; Parke, Andrea PhD[‡]; Malfroid, Kasper MSc[‡]; Sue, Jill MS[‡]; Rothrock, Brandon PhD[‡]; Oakley, Gerard MD[‡]; DeMuth, George MS[‡]; Millar, Ewan BSc, FRCPath^{‡,§}; Fuchs, Thomas J. DSc^{‡,§,¶}; Klimstra, David S. MD[‡]

Author Information

JAMA
Natural
Open

Journal of Pathology Informatics 15 (2024) 100343

Contents lists available at ScienceDirect

Journal of Pathology Informatics

rnal homepage: www.elsevier.com/locate/jipi

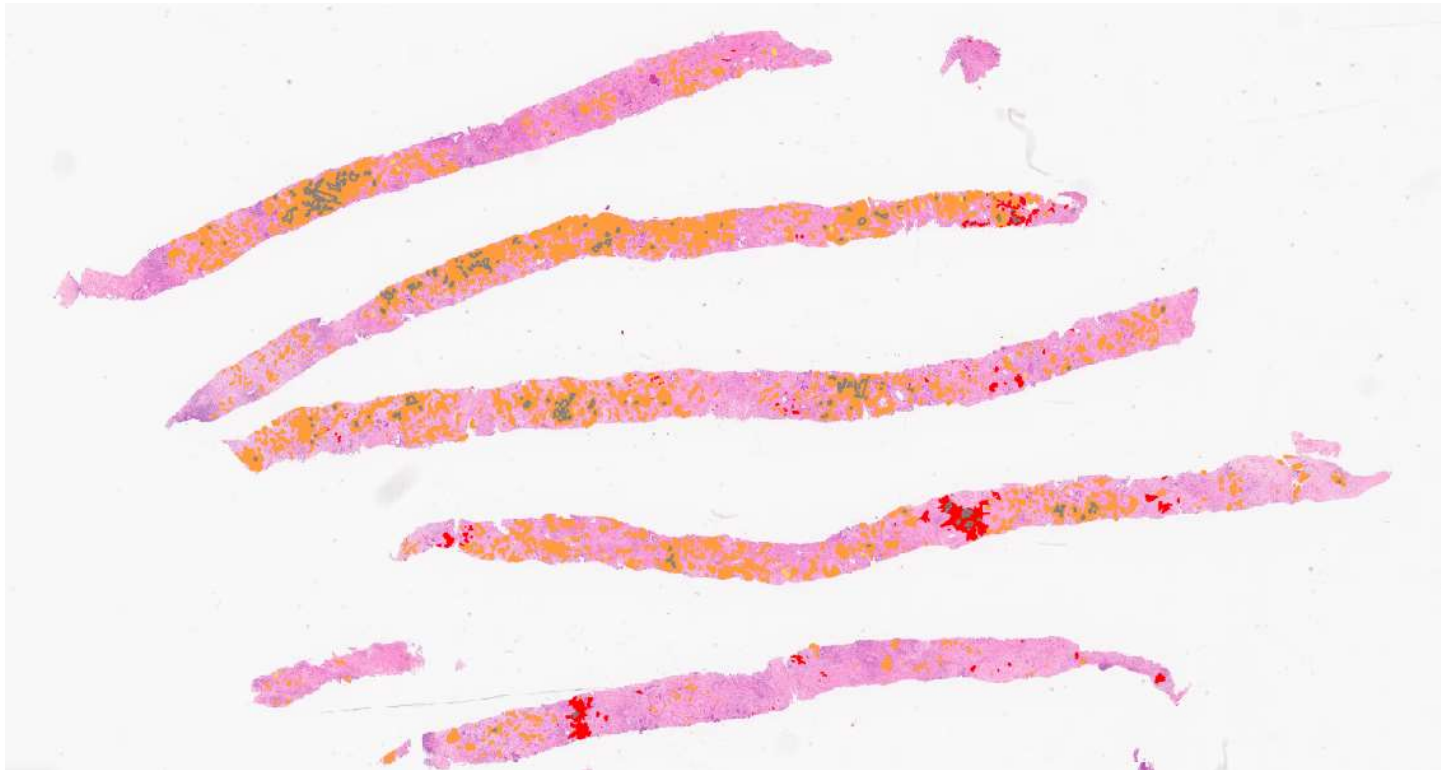


Algorithms to Assess Hormonal Status rays in Patients With Breast Cancer

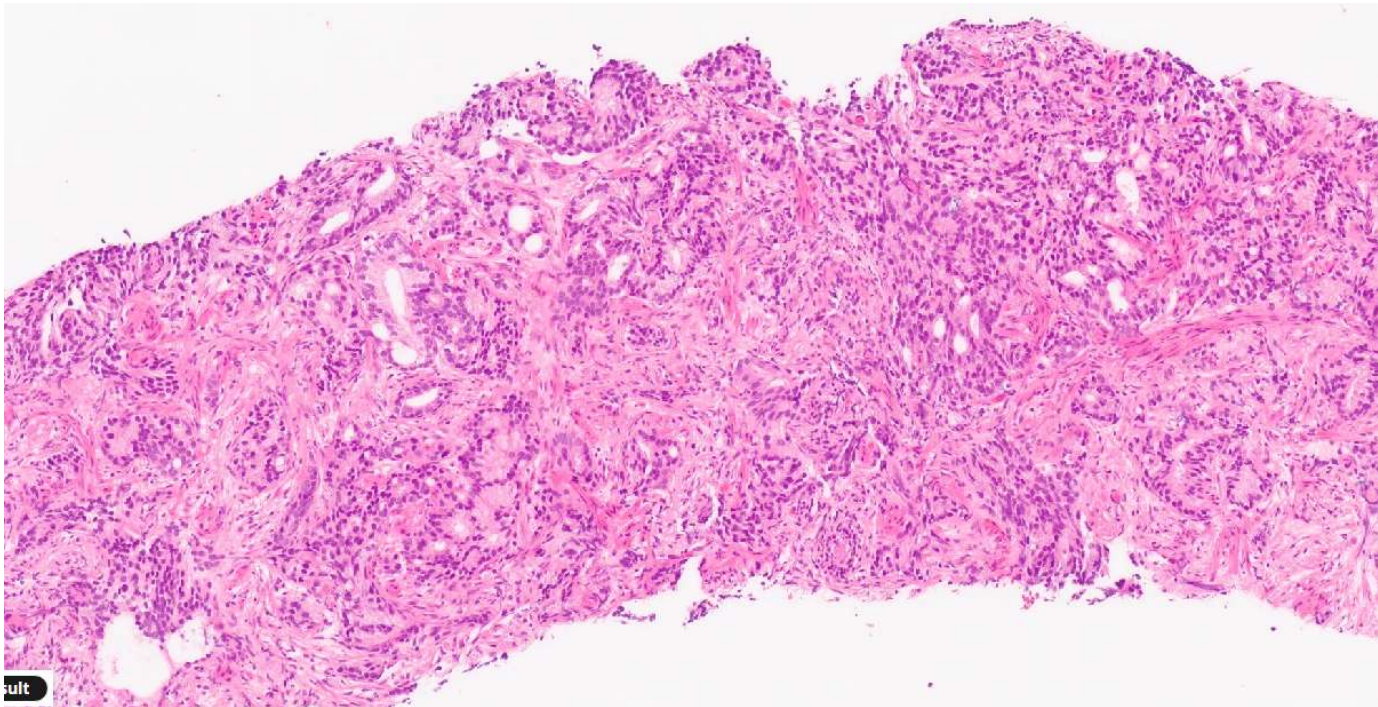
lossberg, MSc; Irit Duek, MD; Ziv Gil, MD, PhD; Ron Kimmel, DSc



LOCAL IMPLEMENTATION AT VGH FOR PROSTATE BIOPSIES



LOCAL IMPLEMENTATION AT VGH FOR PROSTATE BIOPSIES



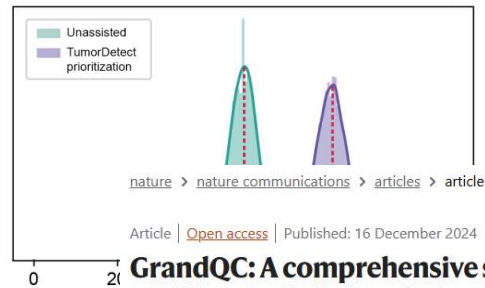
LOCAL IMPLEMENTATION AT VGH FOR PROSTATE BIOPSIES



IMPROVE WORKFLOW/TAT

- Prioritize cases.
- Preorder IHC and tumor marker stains/molecular tests
- Quantify (e.g. Ki67)
- Prepopulate reports
- Quality assurance.

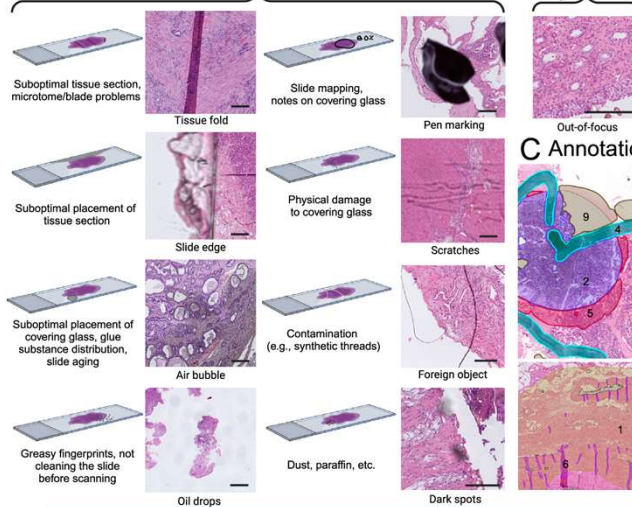
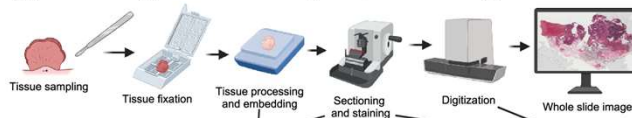
C



GrandQC: A comprehensive solution to quality control

Malignant case:

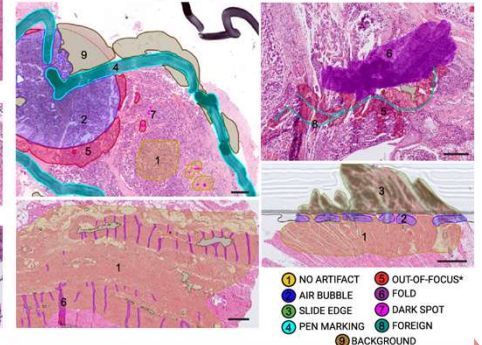
A Different types of artifacts: principles of emergence



B Training datasets

Source	Tissue detection dataset	Artifact detection dataset
TCGA	28	118
UKK	144	287
PAI-WSIT	11	11
Other	10	102
Others	25	4
Other	-	128

C Annotation principles and classes



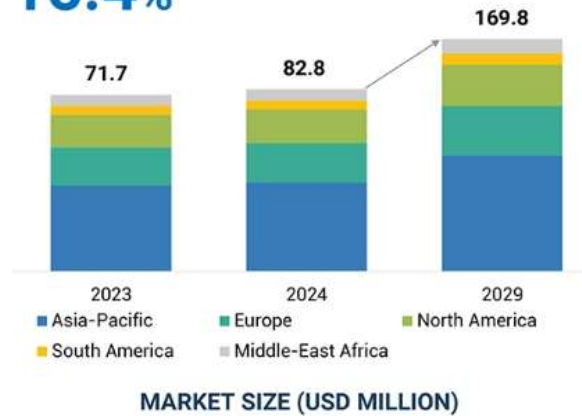
PATHOLOGY AI MARKET

AI IN PATHOLOGY MARKET

Market Size, Market Dynamics & Ecosystem

CAGR of 2024-2029

15.4%



aignostics

indica labs

Stratipath

ARTERA

DiaDeep
FOR PATHOLOGY

AIRA
MATRIX

Roche

aiforia
AI for image analysis

SONRAI
ANALYTICS

OWKIN

DoMore
DIAGNOSTICS

VISIONPHARM

deepbio

GRITIVE

mindpeak

ML

ML

IBEX

Paige

Paige

PathAI

AIRA
MATRIX

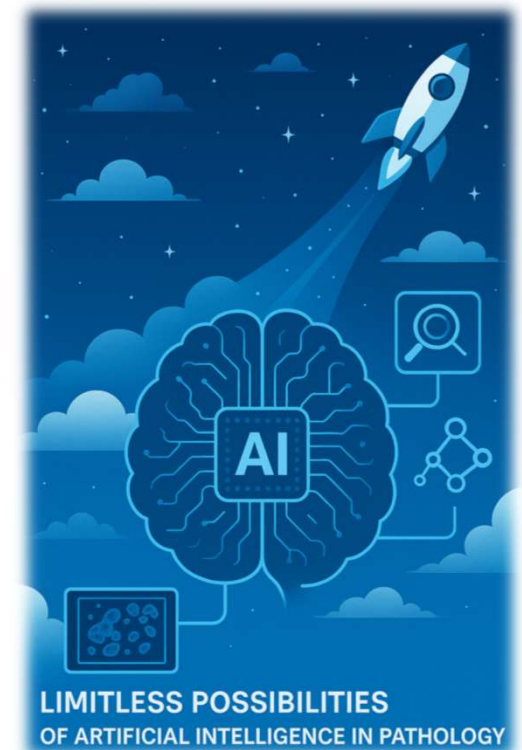
Roche

aiforia
AI for image analysis

SONRAI
ANALYTICS

FUTURE: DISCOVERY & RESEARCH

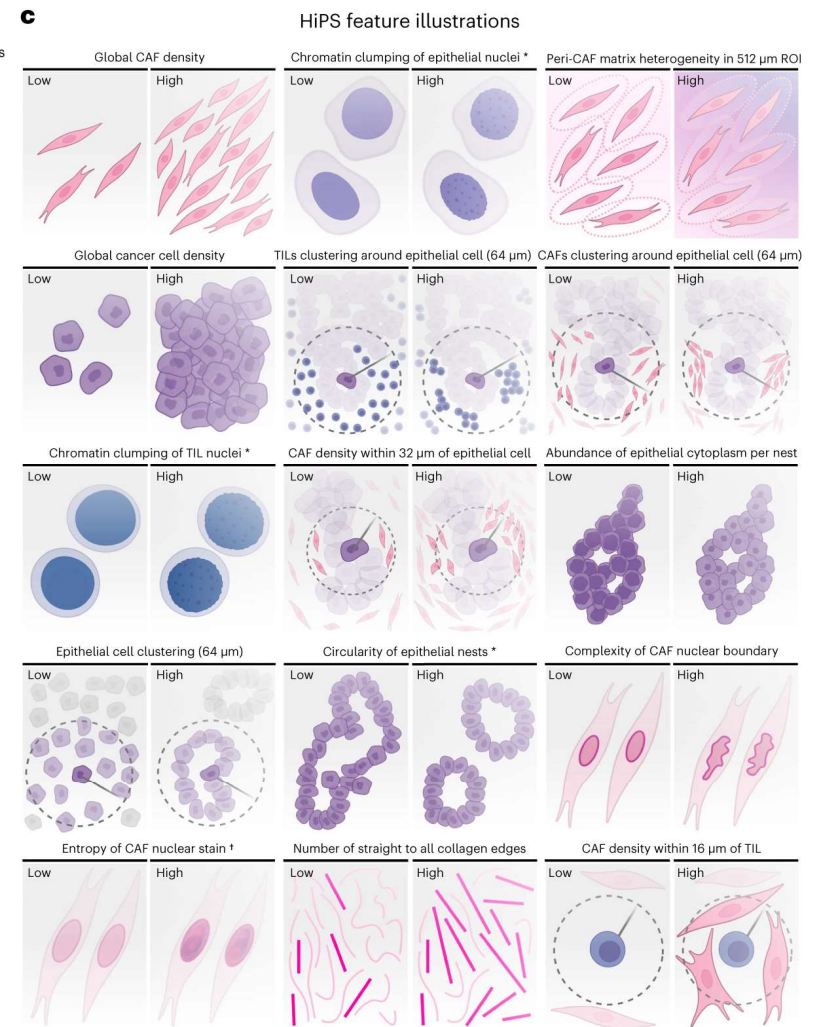
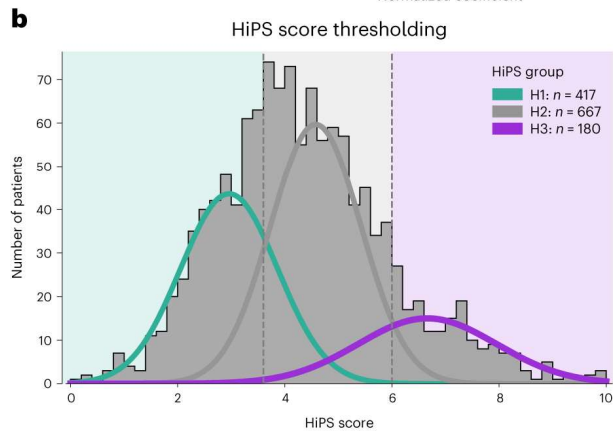
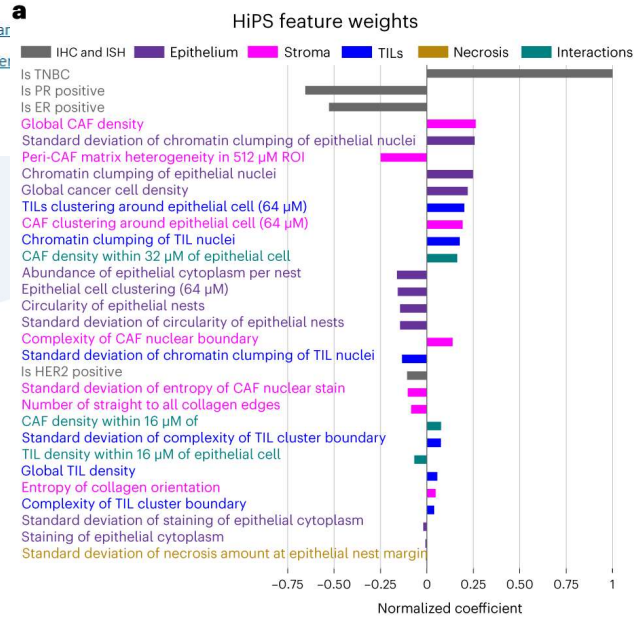
- Novel diagnostic, predictive, and prognostic markers
- Clinical-pathological-radiologic correlation
 - Histology and genomics
 - Combine with AI in clinical medicine
 - To improve prognostication and treatments



A population-level digital histologic biomarker for enhanced prognosis of invasive breast cancer

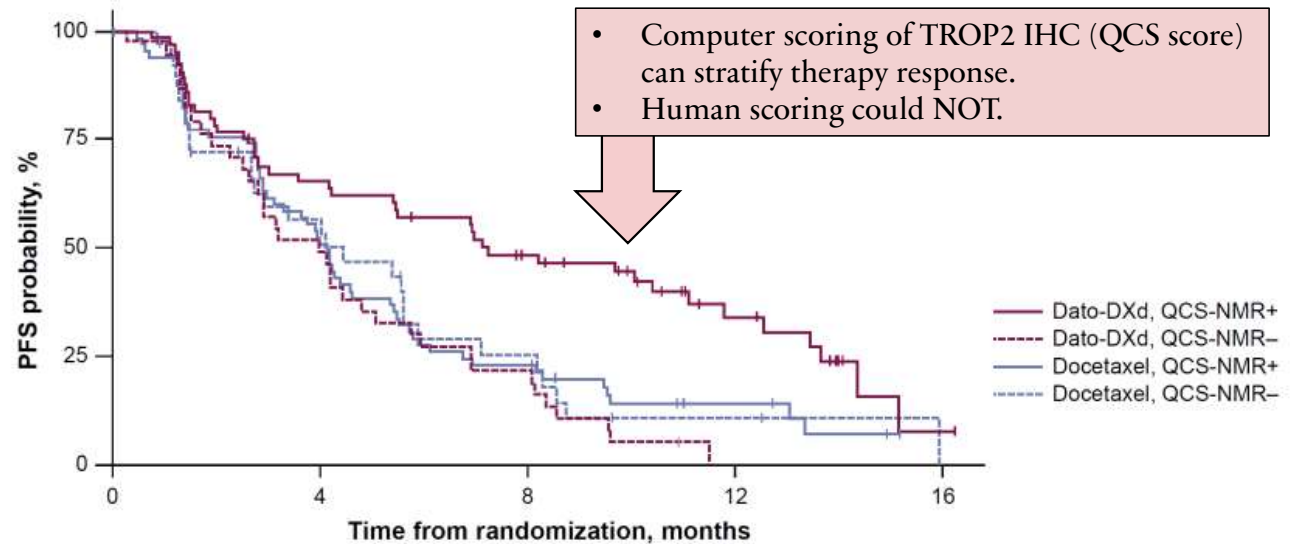
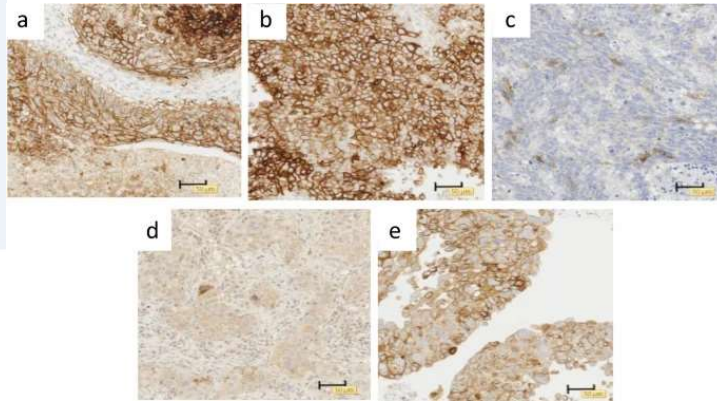
Mohamed Amgad, James M. Hodge, Maha A. T. Elsebaie, Clara Bodelon, Sar A. Gutman, Kalliopi P. Siziopikou, Jeffery A. Goldstein, Mia M. Gaudet, Laure

Nature Medicine 30, 85–97 (2024) | [Cite this article](#)



NSQ/non-AGA BEP: Efficacy by TROP2 QCS-NMR Status

TROP2 QCS-NMR positivity is predictive for longer PFS with Dato-DXd in the NSQ/non-AGA biomarker-evaluable population



PATHOLOGY GENERATIVE AI/LARGE LANGUAGE MODEL INTEGRATION



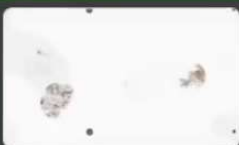
case_032



Slide number A1-1

H&E Suspicious

Yes No



Slide number A1-4

CD3 (T-C) Positive

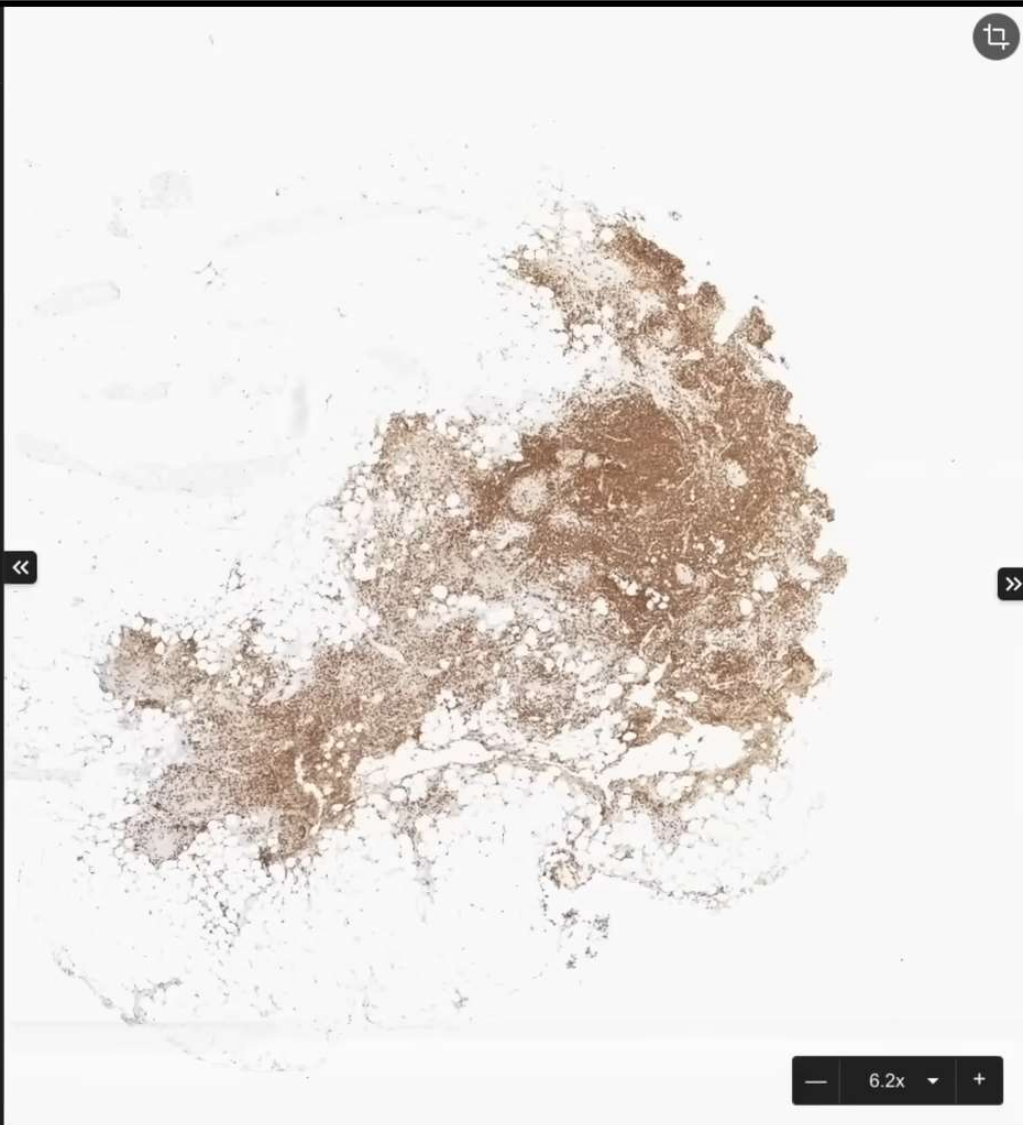
Yes No



Slide number A1-5

CD5 (T-C) Positive

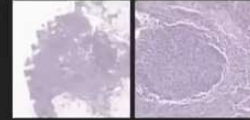
Theme



M

You

This lymph node looks abnormal to me. Please describe what you see and whether this is abnormal for an abdominal lymph node or not.



PathChat

The ROI images of the lymph node show a diffuse infiltrate of small lymphocytes, characterized by small, round nuclei and scant cytoplasm. The normal architecture of the lymph node has been effaced due to this diffuse infiltration. There is a follicular structure visible in the second image.

These findings are indeed abnormal for an abdominal lymph node, as they suggest a lymphoproliferative disorder.

Current slide: A1-4

M

You

What cells does CD3 stain for and are there any in this slide?



PathChat

CD3 is a pan-T-cell marker, which means it is primarily used to



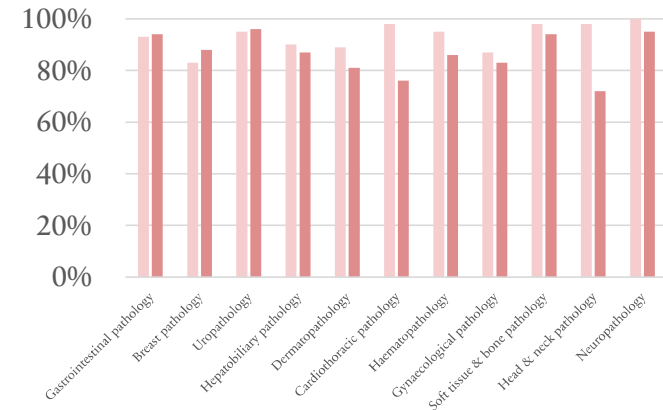
Type your message here...

CHALLENGES TO IMPLEMENTATION OF AI

- Practical
 - Digital pathology – big investment/big infrastructure/big storage
 - Workflow changes
 - \$\$\$ for AI software
 - Lack of standardization (stainers, scanners, image managers, file formats, compression, etc)
- Safety
 - Reliability
 - Single feature vs multiple features vs all features
 - Trust (too much dependence)
- Ethical
 - Bias
 - Responsibility

Published May 2024
 Data from studies up to June 2022
 npj | digital medicine
 Published in partnership with Seoul National University Bundang Hospital
 Review article

Artificial intelligence in digital pathology: a systematic review and meta-analysis of diagnostic test accuracy



VGH EXPERIENCE

GOOD

- Highlights areas to look at

BAD

- Slow processing
- Inconsistent results
- Multiple software crashes

“... the only pathologists to be replaced by AI may be the inflexible ones unwilling to go digital and use AI to assist them in their jobs.”

van Diest PJ, et al. Histopathology. 2024 May;84(6):924-934.

ACKNOWLEDGEMENTS

- Bobby Grewal
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- Lise Matzke
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THANK YOU

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