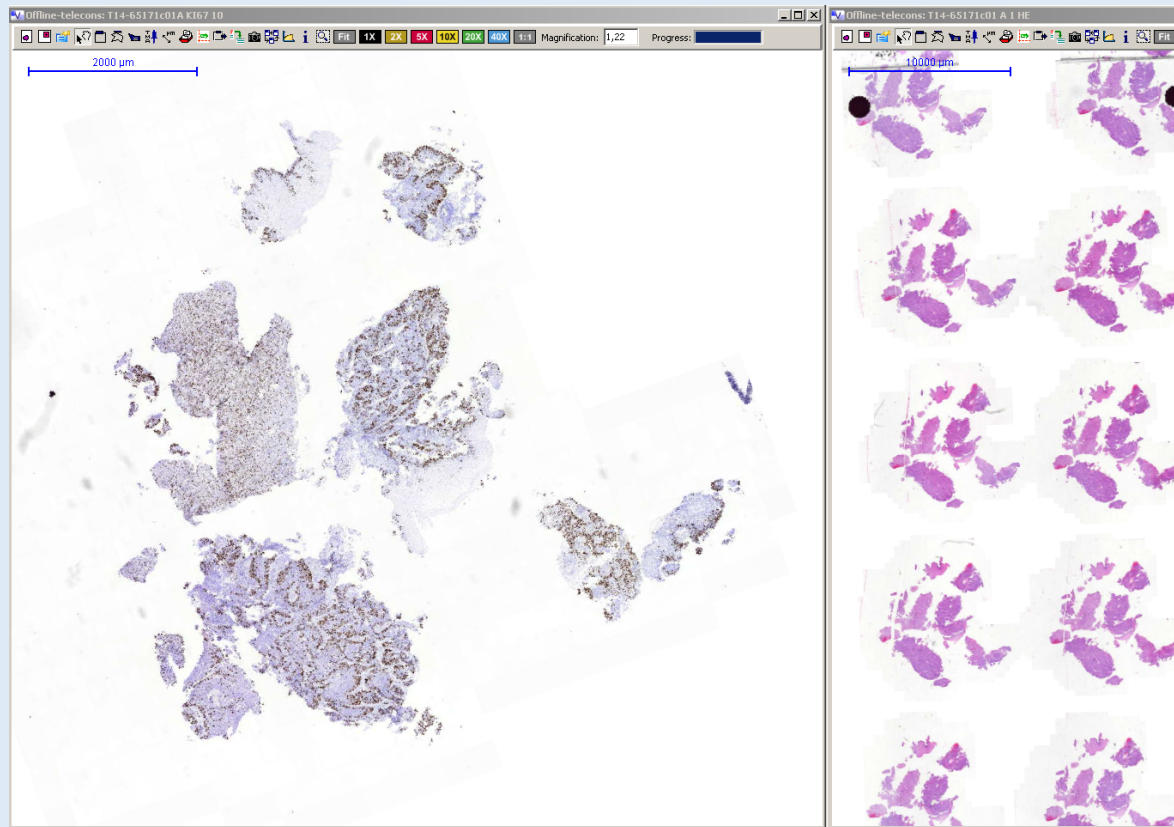


Digital Pathology. From
“in house “experiment to
independant remote
service.



Marius Nap MD PhD
Consultant for digital Pathology
NPC

Storage and information.



97,27 MB

1413,8 MB

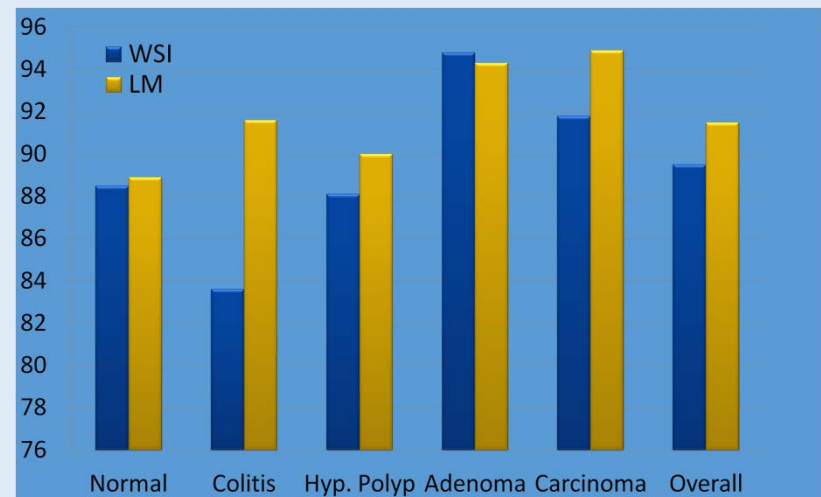
The evaluation of colon biopsies using virtual microscopy is reliable.
[Histopathology](#). 2013 Jul;63(1):114-21.

RS van der Post, JAWM van der Laak, B Sturm, R Clarijs, HE Schaafsma, JH van Krieken, M Nap



Good diagnostic accuracy and reproducibility for digital microscopy of colon biopsies (n=295)

- Overall concordance with the criterion standard: 89.5% for WSI versus 91.5% for LM
- Good intraobserver agreement for WSI (Kappa 0.78) and higher than the interobserver agreement for LM (Kappa 0.71)



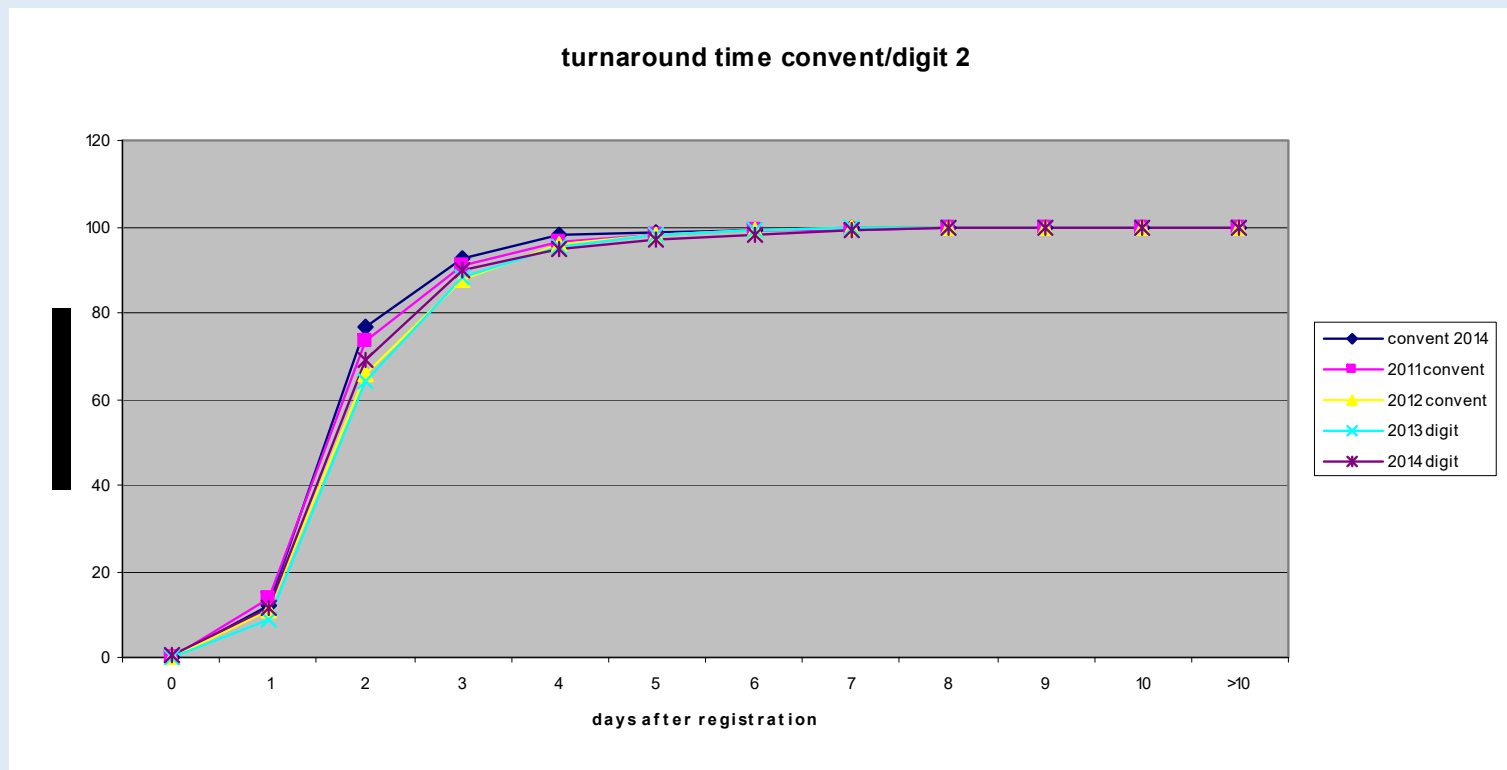
WSI: Whole slide images
LM: Light microscopy

Diagnostic...

External revision concordance

•	• 2010	• 2011	• 2012	• 2013
•	•	•	•	•
• Histology production	•	•	•	•
• A	• 5248	• 5158	• 5112	• 5268
• B	• 5958	• 6156	• 5863	• 5549
• C	• 6514	• 5924	• 6542	• 5558
• D	• 5783	• 5935	• 6283	• 5597
•	•	•	•	•
• external revisions concordance	•	•	•	•
• A	• 1,70%	• 1,96%	• 1,51%	• 1,59%
• B	• 1,19%	• 1,45%	• 1,47%	• 0,88%
• C	• 1,12%	• 1,30%	• 1,54%	• 1,30%
• D	• 1,14%	• 1,38%	• 1,07%	• 1,04%
• external revisions not concordant	•	•	•	•
• A	• 0,10%	• 0,02%	• 0,10%	• 0,03%
• B	• 0,03%	• 0,00%	• 0,00%	• 0,00%
• C	• 0,08%	• 0,00%	• 0,08%	• 0,03%
• D	• 0,00%	• 0,05%	• 0,08%	• 0,02%

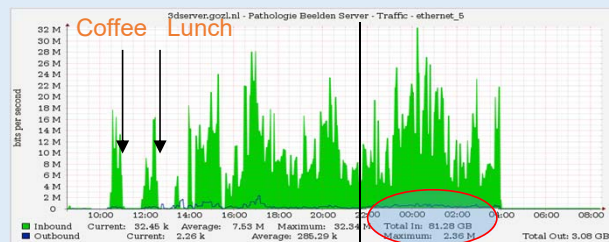
Is there an effect of digital on diagnostic output and turnaround time?



Before going digital.....PRI

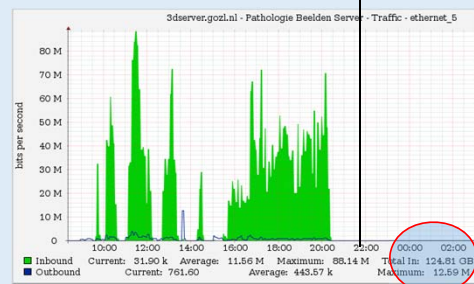
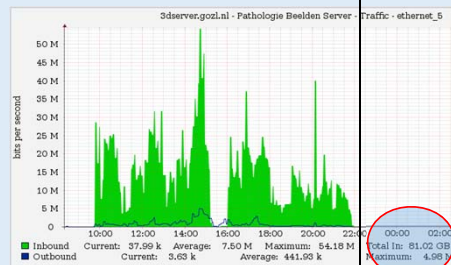
Automatisch opslaan

Scan to Server: Daily network consumption 2013



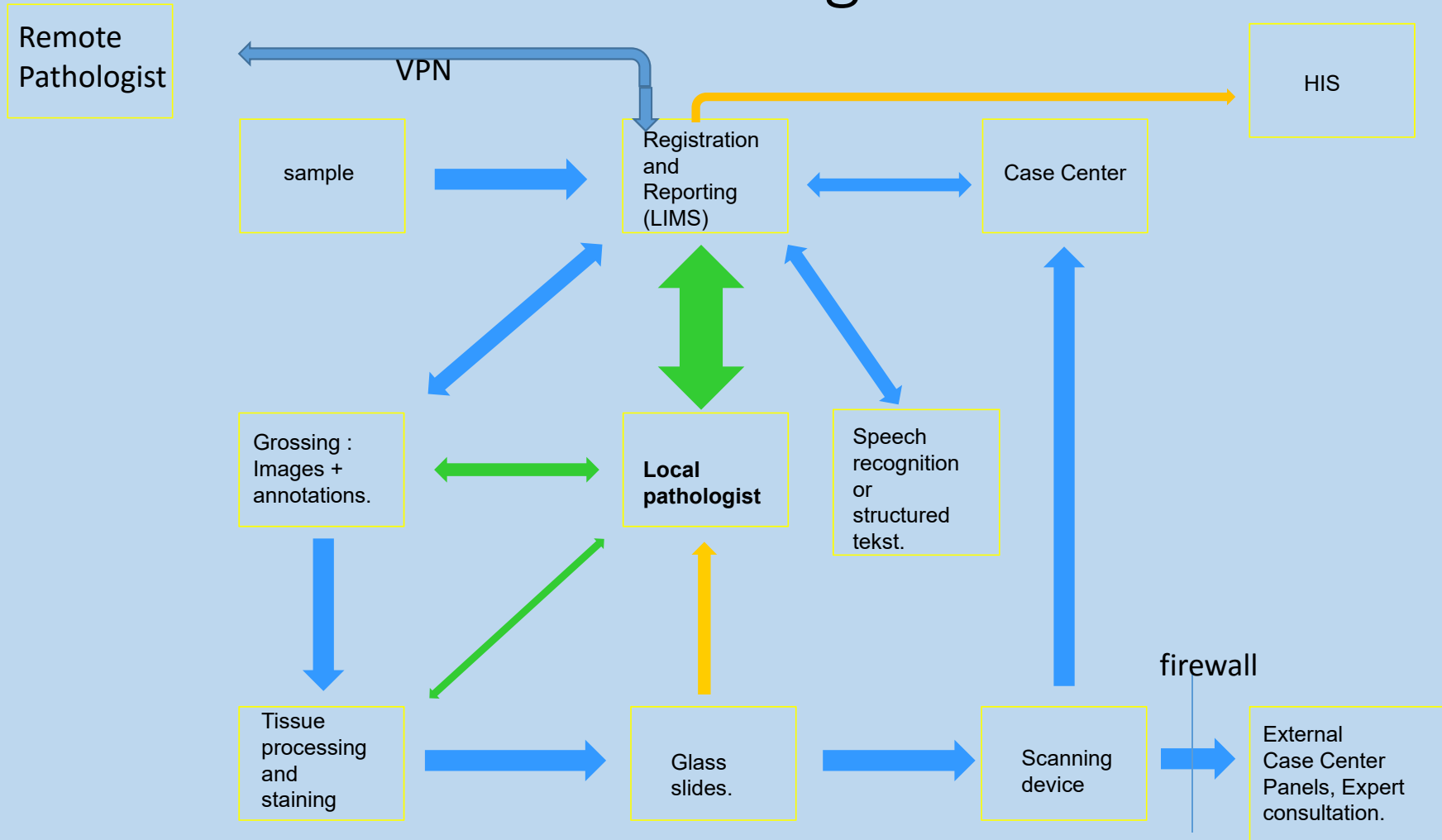
Green= Scan to Server.
Black = Server to Workstation

Max
1Gb/s

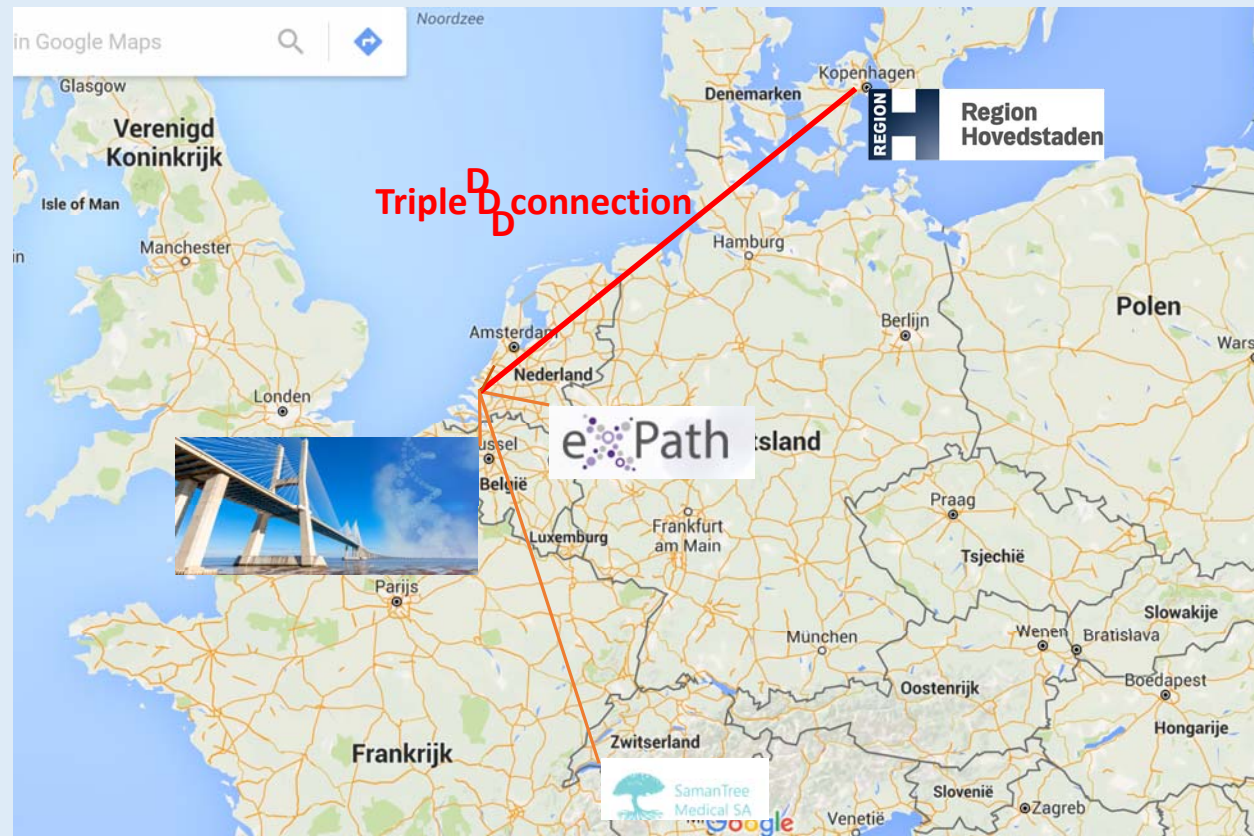


Effect of scanning
disciplin and hardware
on total volume and
turnaround time as
part of the diagnostic
process

Safe Process Integration



Crossing borders in digital pathology.



Dutch
Danish
Digital
connection

Remote services and Gross images.

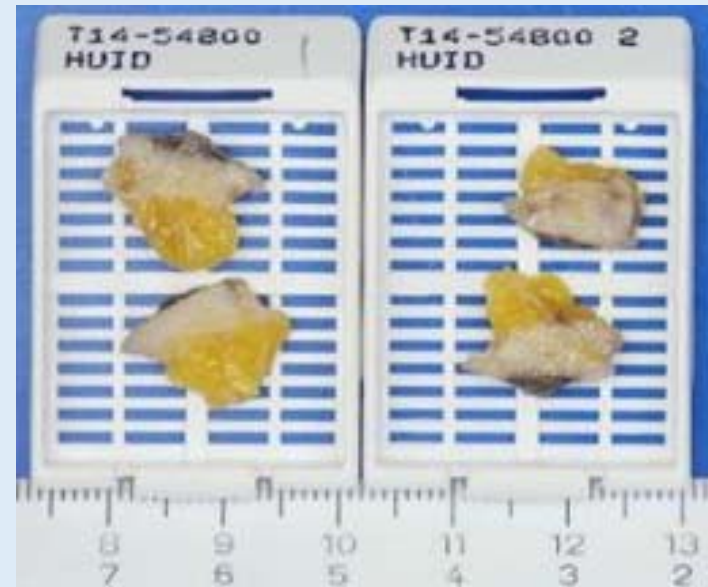
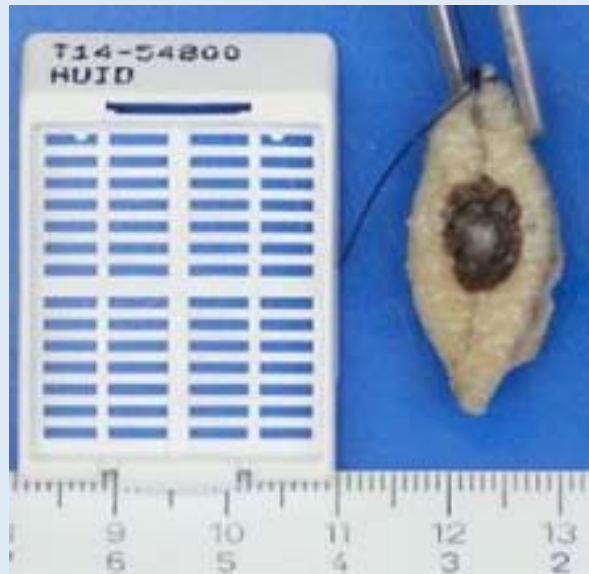


Galbladder + stone +....

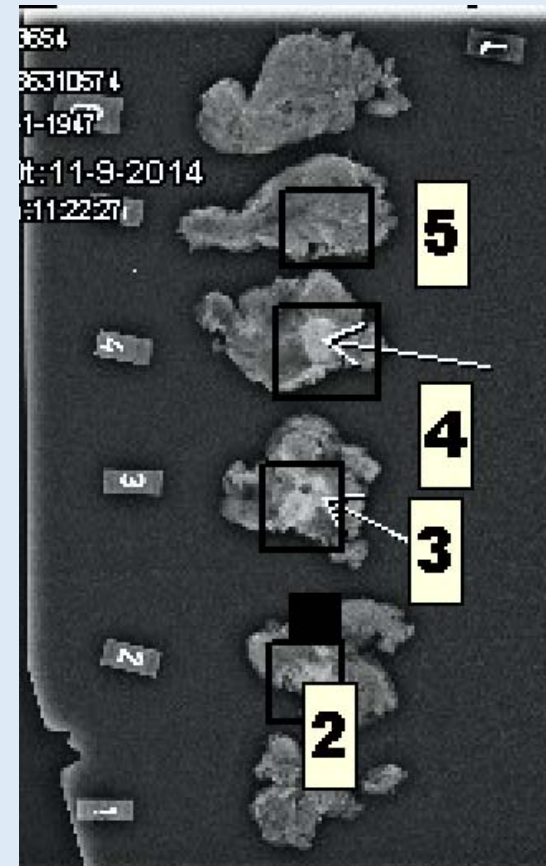


Digital from gross to...

Reducing text and improving information

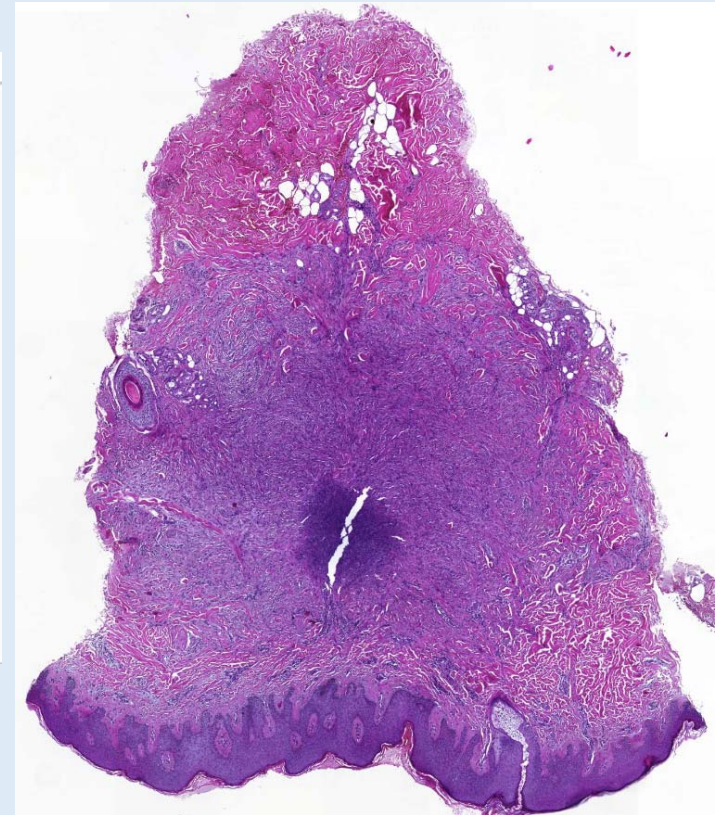
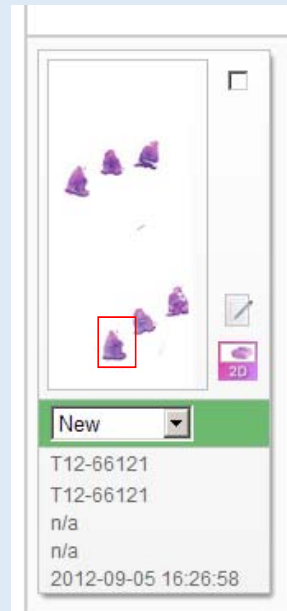
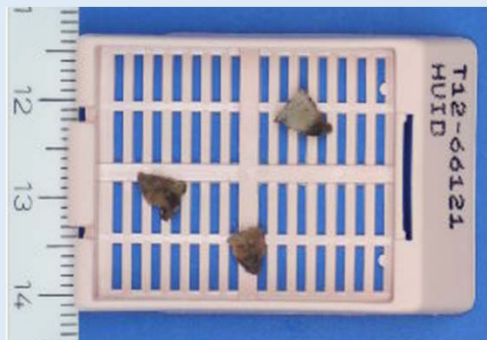
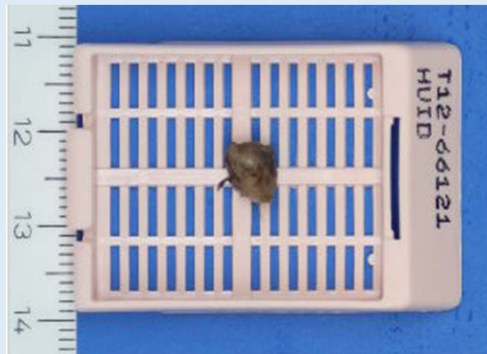


Breast lamellogram + annotations



What happened in the grossing room...

Patient safety, reducing risk factors.

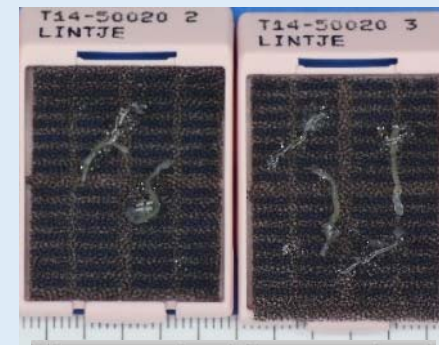


Needle core biopsies.

How deep is deep enough?



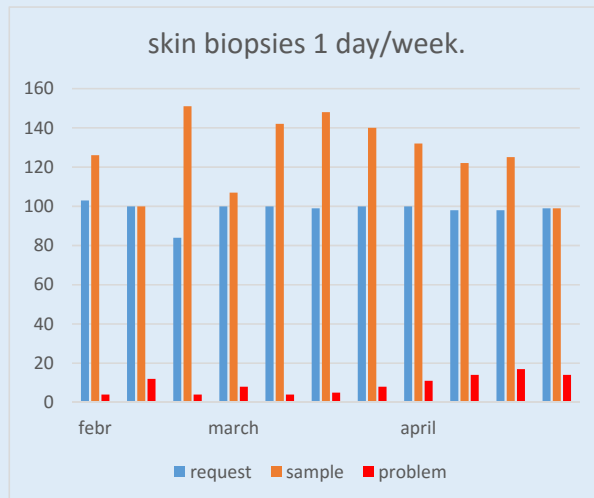
New	New	New
T14-50020c01	T14-50020c01N1+2	T14-50020c01N3
T14-50020c01	T14-50020c01N1+2	T14-50020c01N3
n/a	n/a	n/a
n/a	n/a	n/a
2014-01-03 15:28:35	2014-01-06 17:30:18	2014-01-06 17:29:19



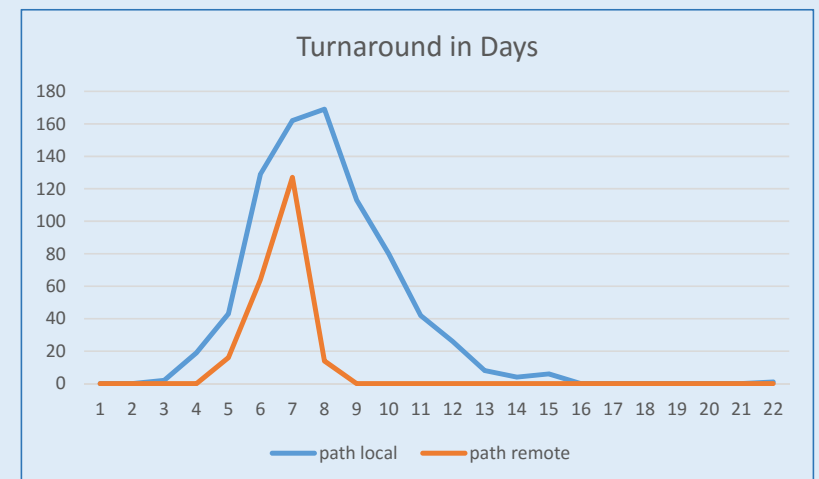
New	New
T14-50020c02	T14-50020c03
T14-50020c02	T14-50020c03
n/a	n/a
n/a	n/a
2014-01-03 15:29:38	2014-01-03 15:31:29

Crossing borders in digital pathology.

- Why?
 - Disbalance between workload and workforce.
 - Both in volume and specialized areas
- What?
 - Volume
 - Neoplastic skin biopsies. (5878 cases in 2016) (3916 cases in 2017) (1.2 sections on average)
 - Specialized
 - Neoplastic lung resections (51 cases in 2016) , (99 cases in 2017) (27 sections on average)
 - Inflammatory bowel biopsies and resections (261 cases from august – november 2017) (8 sections on average)



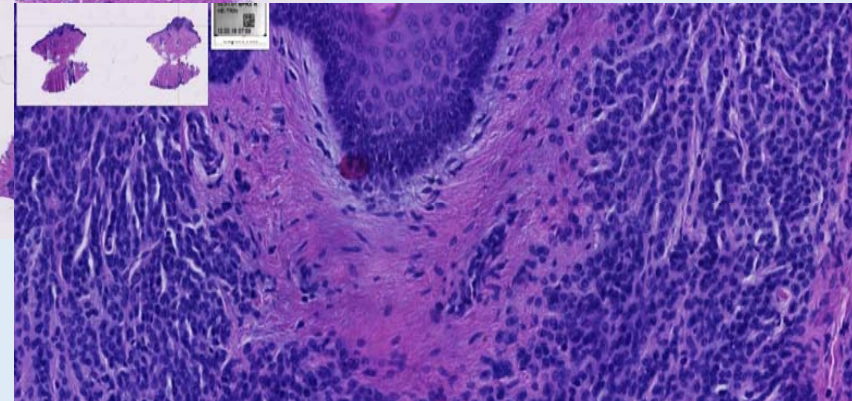
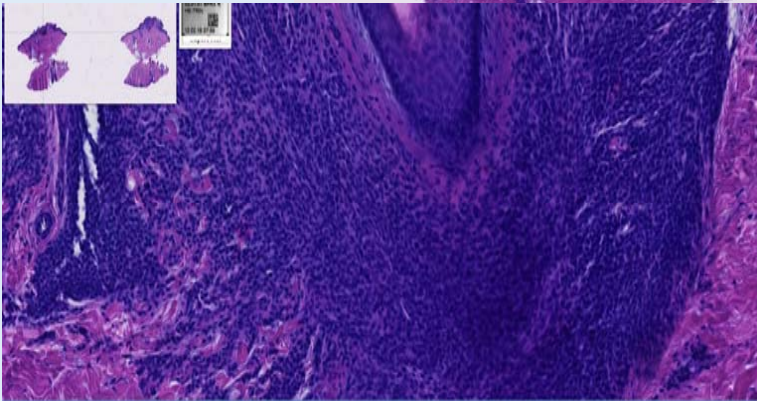
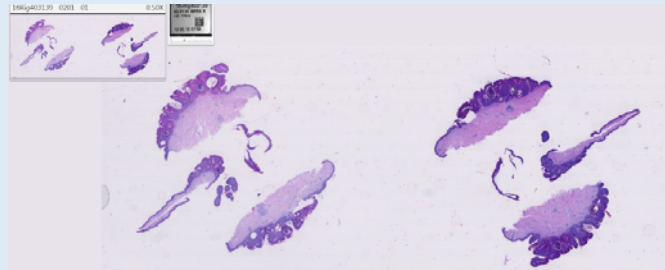
The % problematic cases has Stabilized in 2016 and 2017.
 5-6% returned because of a more complex formulation or follow up.
 6-7% deeper cuts HE next day.



Crossing borders in digital pathology.

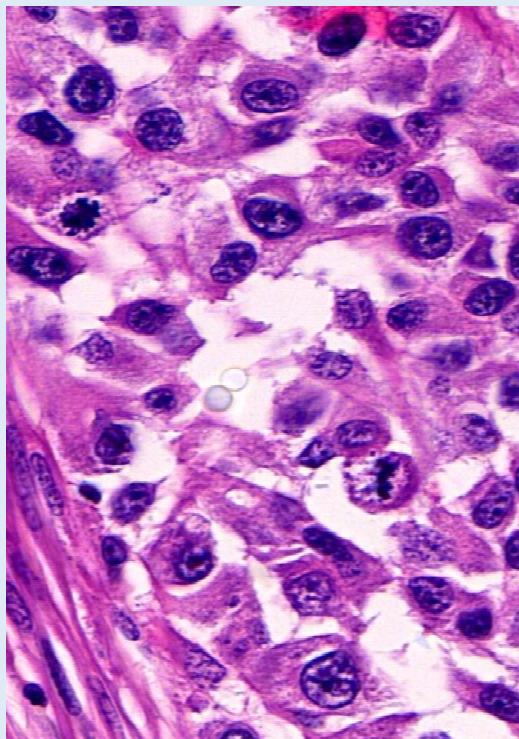
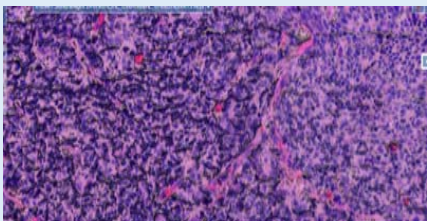
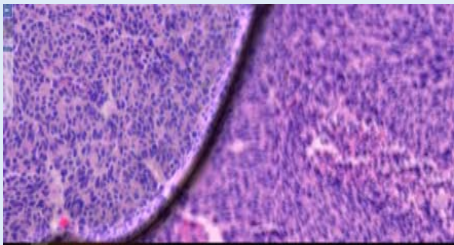
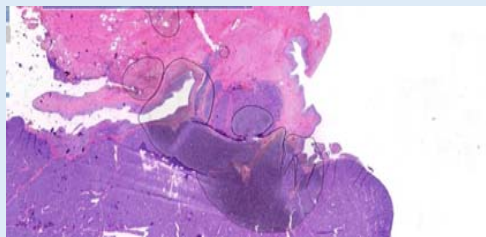
- How? (Official registration with national health care authorities and individual license to.....)
 - Du har hermed pr. 07. oktober 2015 opnået autorisation som Læge
 - Du har hermed pr. 07. oktober 2015 opnået tilladelse til selvstændigt virke som Læge.
 - Du har med virkning fra 07. oktober 2015 opnået speciallægeanerkendelse I Patologisk anatomi og cytologi.
- Digital Pathology and Secure connection.
- Integrated report / image access.
- Standard reporting
 - Volume: codes and fixed text blocks in <<Language>>.
 - Specialized: structured microscopy in <<Language>> / English, SNOMED indexing in <<Language>>.
- Teamwork
 - Logistic
 - Diagnostic.

The effect of artefacts.

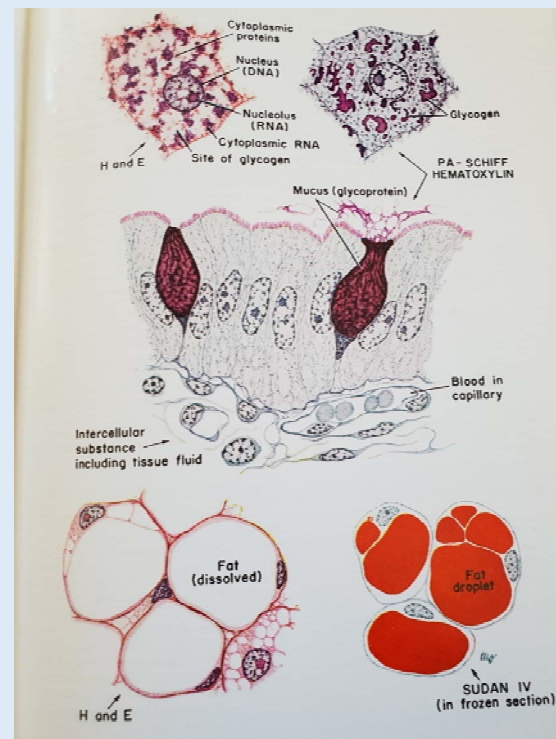
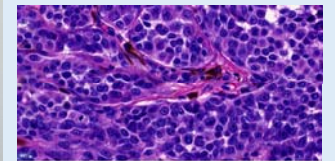
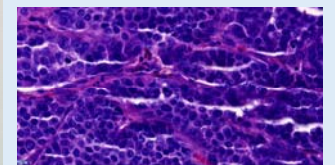
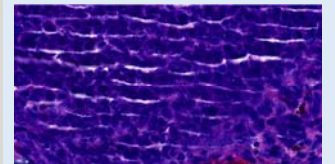
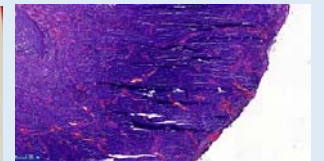


Artefacts and detail...

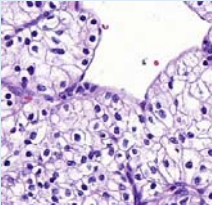
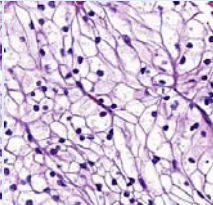
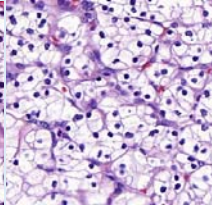
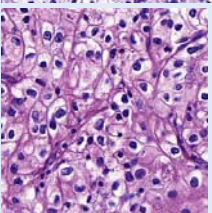
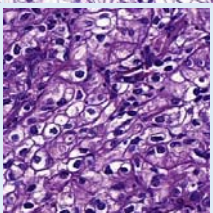
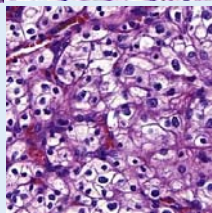
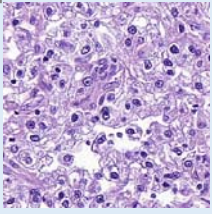
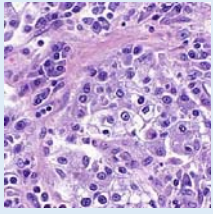
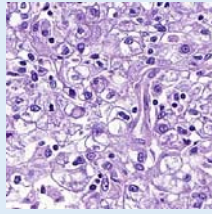
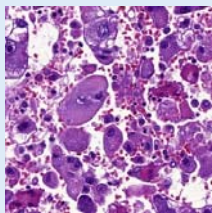
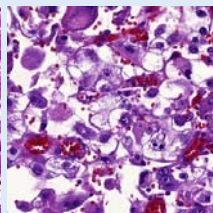
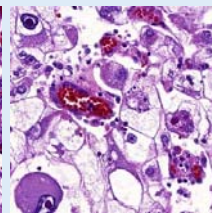
Air trapped under coverslip

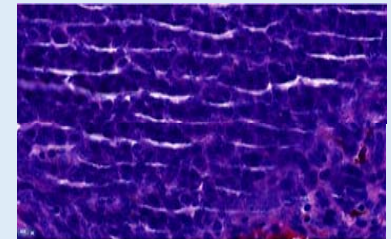


Cutting compression

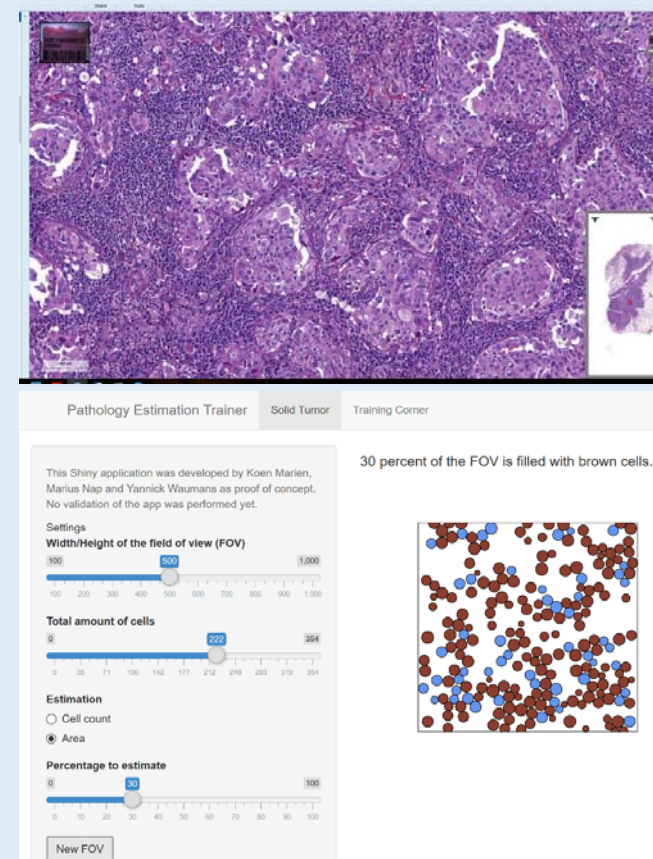
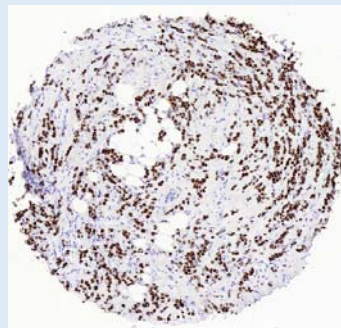
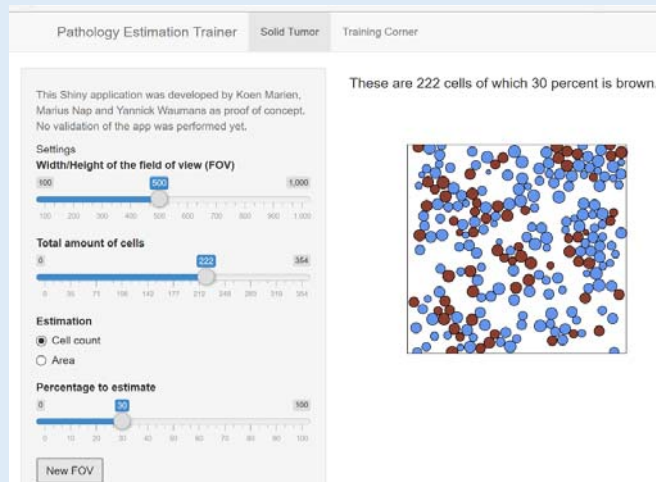


Fuhrman nuclear grade of ccRCC (reference table)

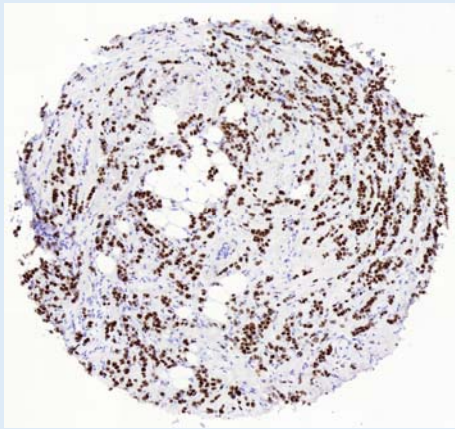
	Steps of estimation			Description	Fuhrman nuclear grade		Image 1 (20X)	Image 2 (20X)	Image 3 (20X)
	Magnification	Criteria	Decision						
1	4x-20x	Size Shape Nucleoli Chromatin Pattern	On low magnification you can decide whether the tumor is in one of the two boundaries Fuhrman 1 or 4	Small and uniform nuclei up to 10 µm approximately as Ly or Er, highly condensed chromatin (nuclei are seen as ink dots), not visible details in chromatin and no nucleoli	1	Low-grade tumors			
2	20x-40x	Size Shape Nucleoli Chromatin Pattern	Always search for darker areas in the tumor. Carefully search for presence of nucleoli	Bigger nuclei up to 15 µm (2x Ly or Er), irregular outlines of nuclei, visible details of chromatin, few nuclei with open chromatin, visible only few nucleoli in 40x	2				
3	20x-40x	Size Shape Nucleoli Chromatin Pattern	Make sure you don't estimate stromal cells as part of the tumor-cell population (activated Ly, Hist, Giant cells, activated fibroblasts, endothelial cells and pericytes)	Bigger nuclei up to 20 µm (3x Ly or Er), very irregular outlines of the nuclei, many nuclei with open chromatin, variety of chromatin architecture, almost all nuclei are with visible nucleoli even in 20x	3	High-grade tumors			
4	20x-40x	Size Shape Nucleoli Chromatin Pattern	Fuhrman nuclear grade is applicable only for ccRCC. The final grade is based on worst high-powered field in the tumor.	Many big nuclei (bizarre and multilobulated), almost all nuclei are with open chromatin, almost all nuclei are with macronucleoli	4				



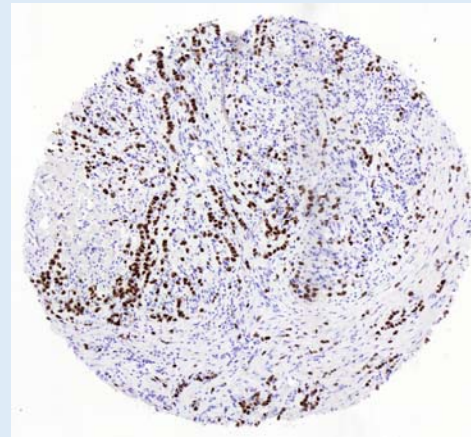
Pathology estimation trainer (i-Game)



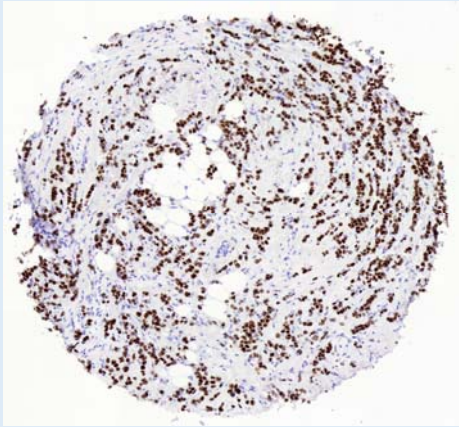
Relative tumor surface and marker positivity.



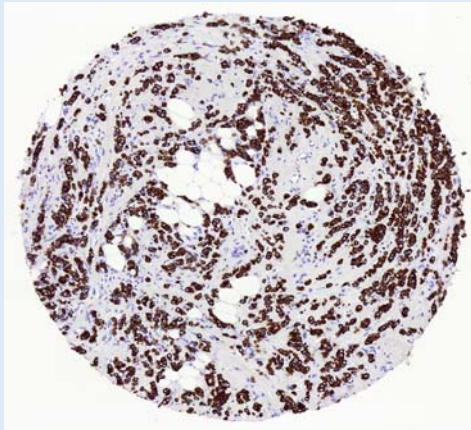
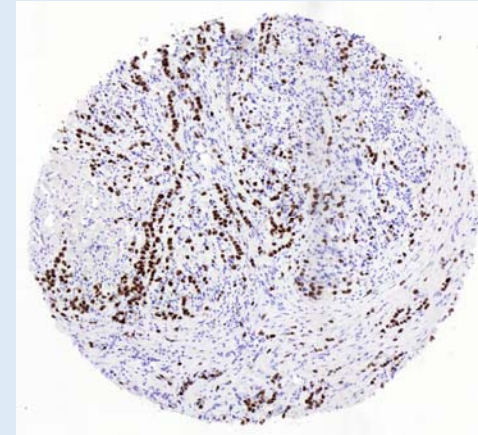
ER



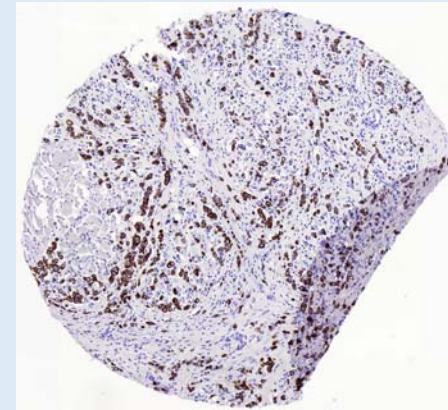
Relative tumor surface and marker positivity.



ER



cytokeratin



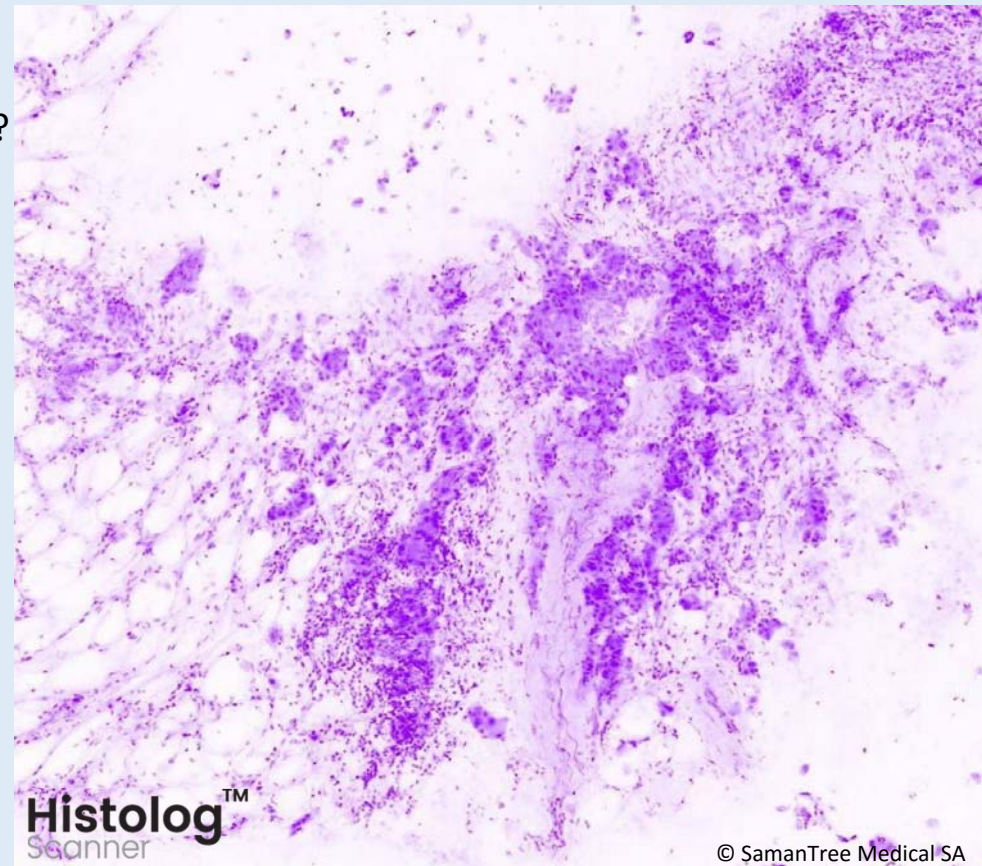
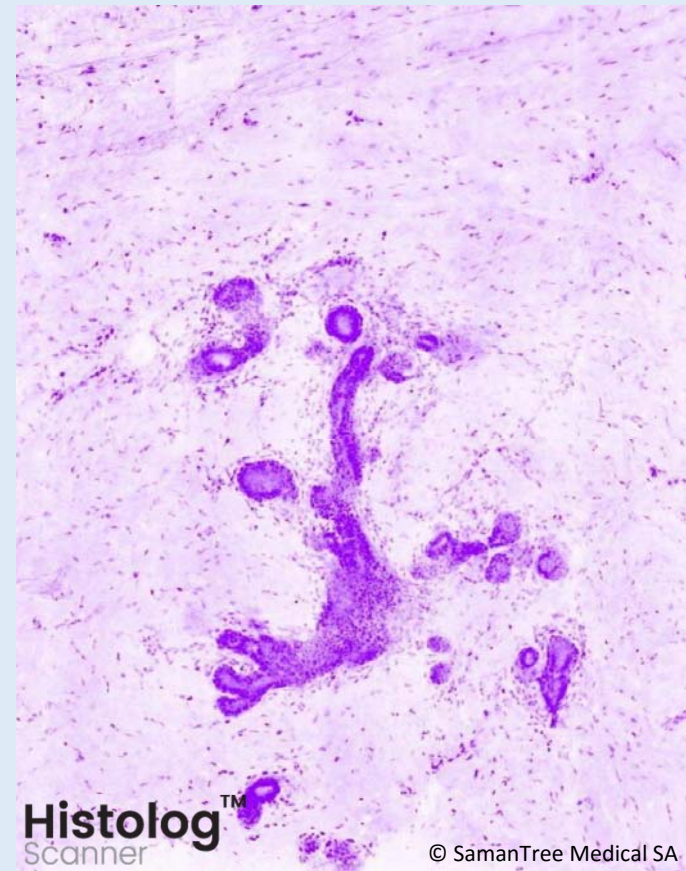
Will we still.....?

Use fixatives?
Use tissue processing?
Use paraffin embedded?
Use microtomes ?
Have glass slides ?
Use H&E stains ?

After **2025?**

OR....

Will technology allow
us to generate
histological images
without all these
artefacts?

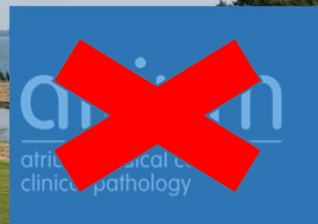




2012-



2015-



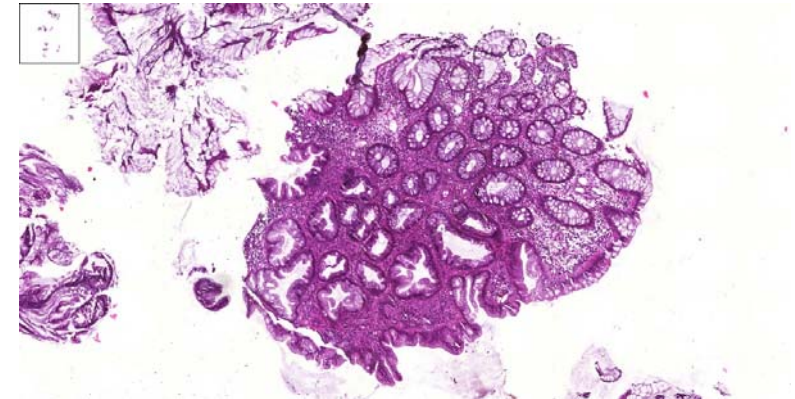
- 2018



Marius Nap MD PhD
Consultant for digital Pathology
NPC

Digital Pathology , can it improve Pathology?

- In routine diagnostics
 - In daily practice,
 - In continuous education.
 - In expert opinions.
- In Pharma Pathology (individualized diagnostics with semi-quantative estimations)
- Technological innovation.
 - CAD, AI, IA, DL, CP...
 - SLI



Simultaneous inspection of multiple biomarkers in serial sections.

