ESO-ESP Digital Pathology Seminar

ONLINE COURSE

PORTO DIGITAL WORKFLOW

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No conflict of interests to declare

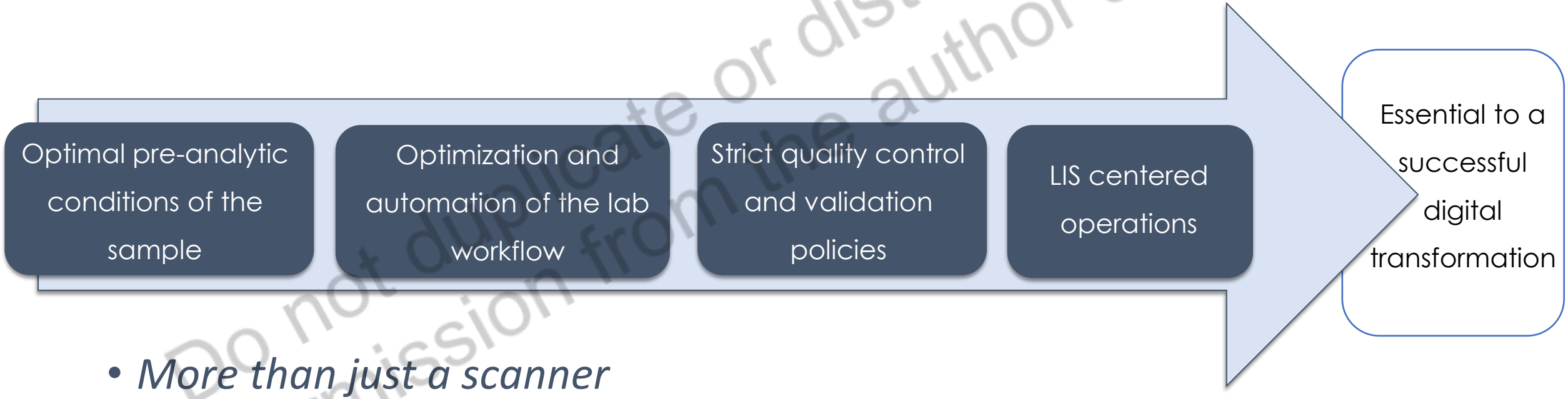
Survey: *Implementação da digitalização de lâminas nos Laboratórios de Anatomia Patológica*

Population: portuguese pathology labs

- 14 valid replies
  - Is there a digital workflow in your lab? : 9 (64.3%) no/5 (35.7%)yes
  - Those who reply NO:
    - Anticipate that telepathology for primary diagnosis and second opinion are the major advantages (66.6%)
    - Anticipate that costs may represent the major obstacles to digital pathology implementation (88.9%)
    - One participant does not consider relevant to undergo digitization (11.1%)
  - Those who reply YES:
    - Admitted that the major alterations operated in the lab contemplated instruments (1-2 scanners), space organization and technical staff scheduling
    - All had educational opportunities regarding digital pathology
    - Only 2 use the scanner for primary diagnosis, one of them does not have a LIS-scanner integration

The digital transformation (for primary diagnosis)

- The holistic concept of *digital pathology* comprehends innovative interventions in all areas of the pathology laboratory

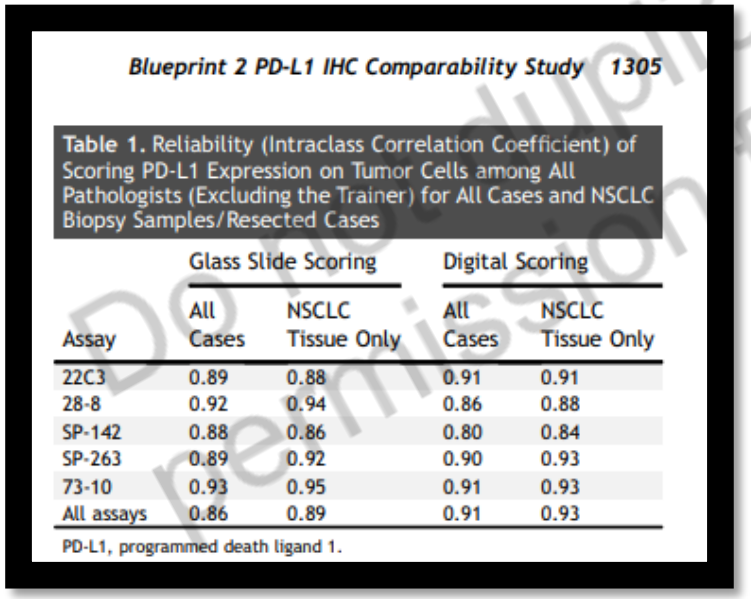


- *More than just a scanner*

A new methodology

in-silico reporting represents an advantage in the diagnostic process

- Digital versus analogic/optical pathology: non inferior accuracy and reliability even in the context of biomarker studies and clinical trials



Blueprint 2 PD-L1 IHC Comparability Study 1305

Table 1. Reliability (Intraclass Correlation Coefficient) of Scoring PD-L1 Expression on Tumor Cells among All Pathologists (Excluding the Trainer) for All Cases and NSCLC Biopsy Samples/Resected Cases

	Glass Slide Scoring		Digital Scoring	
Assay	All Cases	NSCLC Tissue Only	All Cases	NSCLC Tissue Only
22C3	0.89	0.88	0.91	0.91
28-8	0.92	0.94	0.86	0.88
SP-142	0.88	0.86	0.80	0.84
SP-263	0.89	0.92	0.90	0.93
73-10	0.93	0.95	0.91	0.93
All assays	0.86	0.89	0.91	0.93

PD-L1, programmed death ligand 1.

Original Paper | Published: 31 October 2020

Digital Versus Optical Diagnosis of Follicular Patterned Thyroid Lesions

Ayat Aloqaily, Antonio Polonia, Sofia Campelos, Nusaiba Alrefae, Joao Vale, Ana Caramelo & Catarina Eloy

Head and Neck Pathology **15**, 537–543 (2021) | Cite this article

189 Accesses | **2** Altmetric | Metrics

A safe and efficient methodology

The laboratory standards for routine diagnostics in a digital setting are part of the standard accreditation procedures internationally

Validating Whole Slide Imaging Systems for Diagnostic Purposes in Pathology

Guideline Update From the College of American Pathologists in Collaboration With the American Society for Clinical Pathology and the Association for Pathology Informatics

Andrew J. Evans, MD, PhD; Richard W. Brown, MD; Marilyn M. Bui, MD, PhD; Elizabeth A. Chlipala, BS, HTL(ASCP)QIHC; Christina Lacchetti, MHSc; Danny A. Milner Jr, MD, MSc(Epi), MBA; Liron Pantanowitz, MD; Anil V. Parwani, MD, PhD; Kearin Reid, MLIS, MT(ASCP); Michael W. Riben, MD; Victor E. Reuter, MD; Lisa Stephens, MBA, HTLA(ASCP)CM; Rachel L. Stewart, DO, PhD; Nicole E. Thomas, MPH, CT(ASCP)CM

The usage of WSI stimulates an increment in the quality control measures

Digital pathology is a cost-effective model with direct and parallel significant achievements

The main advantages of using WSIs

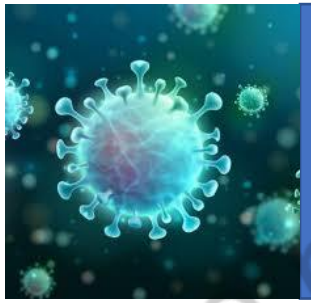
Digital pathology and COVID-19: with the COVID-19 crisis, many national and international agencies have revisited their criteria to encourage the adoption of digitalization into routine pathology

EDITORIAL

J Pathol Inform 2020, 11:15

The future of pathology: What can we learn from the COVID-19 pandemic?

Bethany J Williams[1], Filippo Fraggetta[2], Matthew G Hanna[3], Richard Huang[4], Jochen Lennerz[2], Roberto Salgado[5], S Joseph Sirintrapun[6], Liron Pantanowitz[2], Anil Parwani[7], Mark Zarella[8], Darren E Treanor[9]



Sharing

Using the digital image to reduce the distance between people and maintain quality of diagnoses

Internal and external consultation of cases
Annotation of specific diagnostic doubts
Validation of staining at distance and using archived images
Pathologists and technicians work at distance

Digital pathology and the opportunity for integrating artificial intelligence (AI) into routine pathology practice

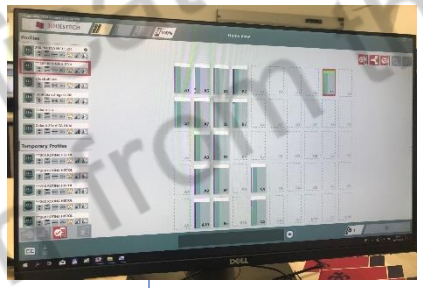
Digital transformation (2016-2020) at IPATIMUP

8th July

2019

21st October

Integration with LIS



6th November

Protocol optimization

11th November

QA program

January – July 2020

Validation for primary diagnosis

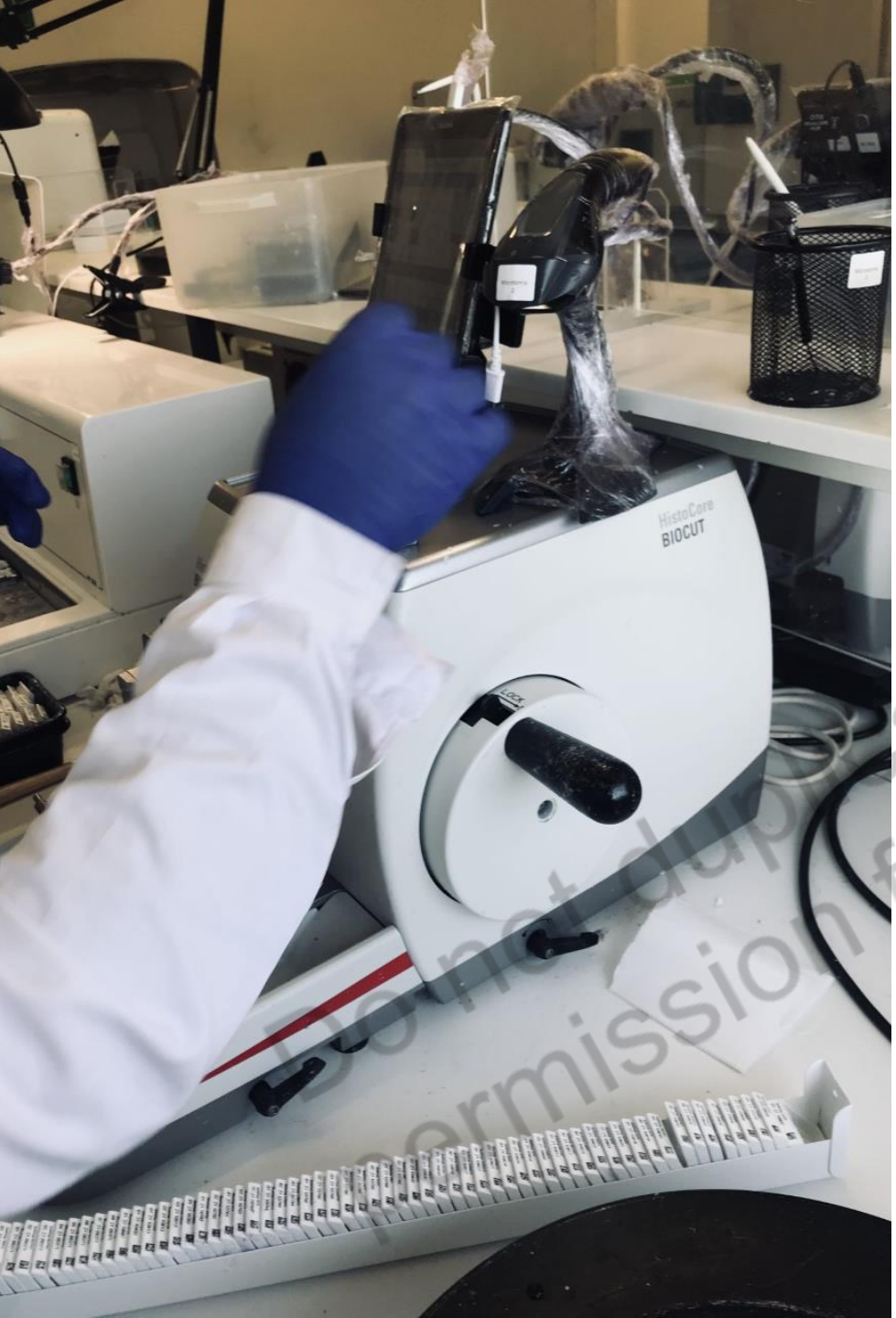
2020

July

Full digital

Time line

Time line

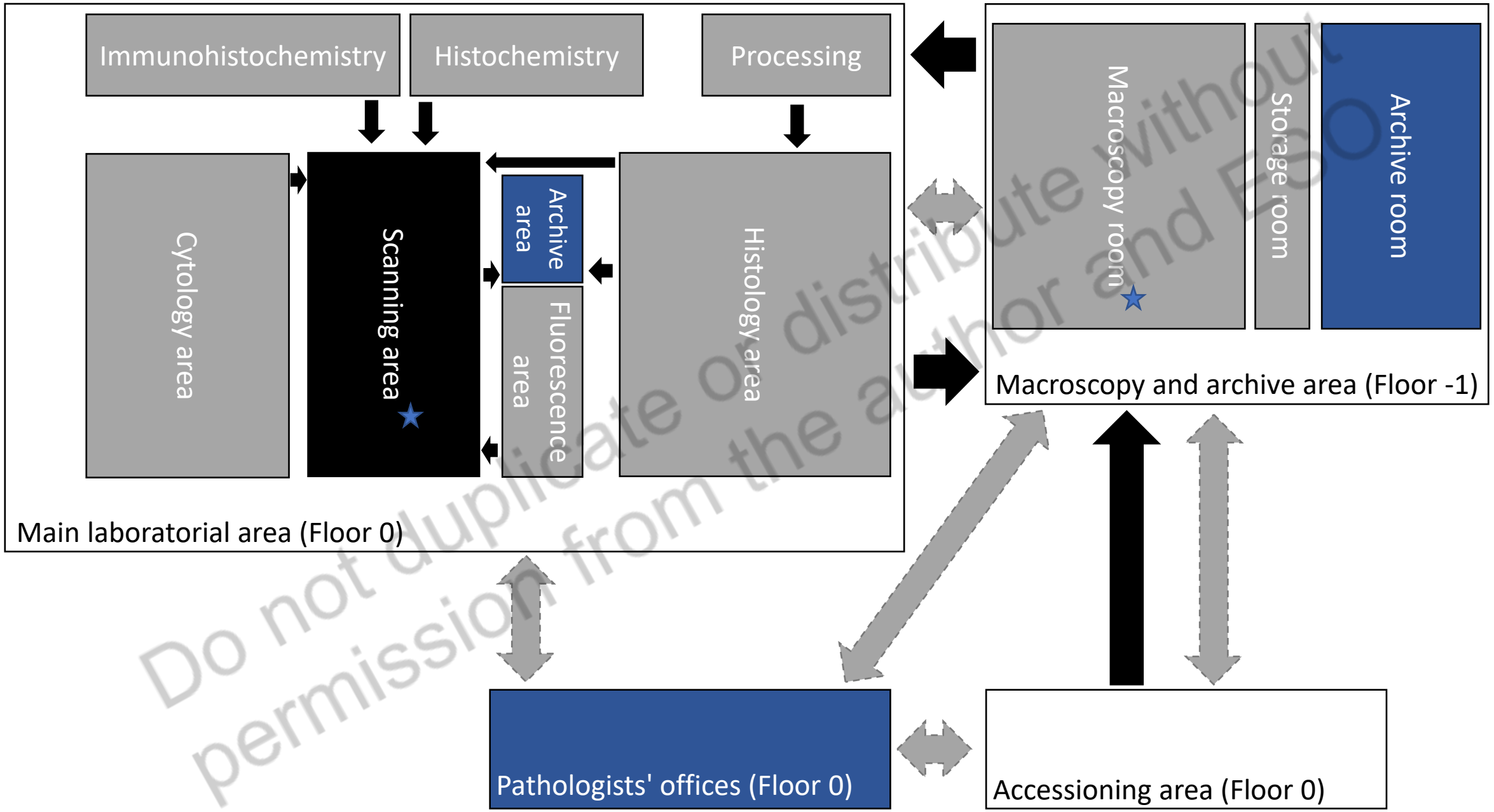


Involving the team in the process of digital transformation

Training the staff: technicians and pathologists

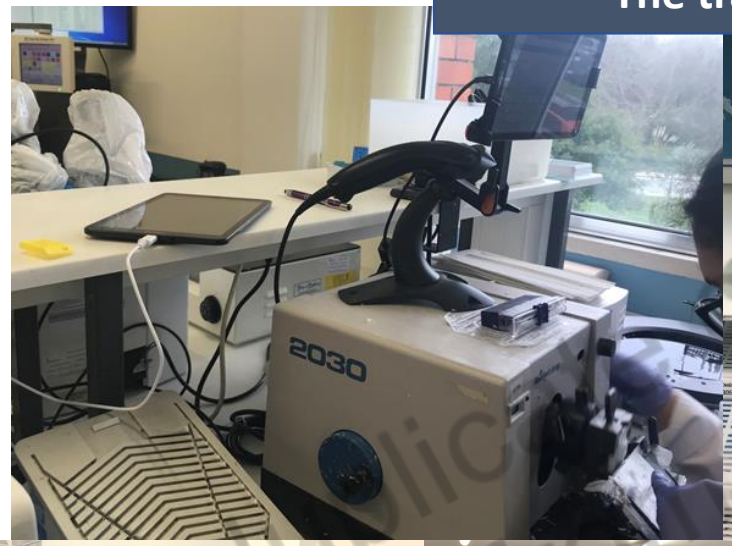
- Improvement /automation of the pathologist's and technician's workstations

- Equipment
- Environment
- Space management
- Workload management

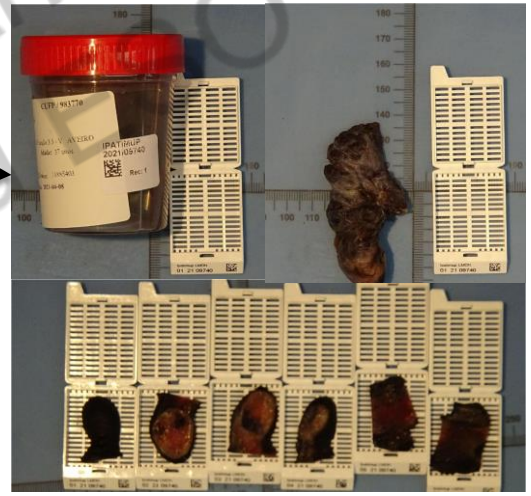


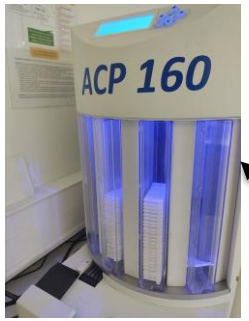
Sparing valuable resources
Space, time, people and instruments (Lean)

The tracking system



Spare valuable resources – macroscopy room





Computer with code reader

Double ventilated hood

Computer with code reader

Cassette printer

Pending exams

New specimens for grossing

Specimens/ containers waiting for storage

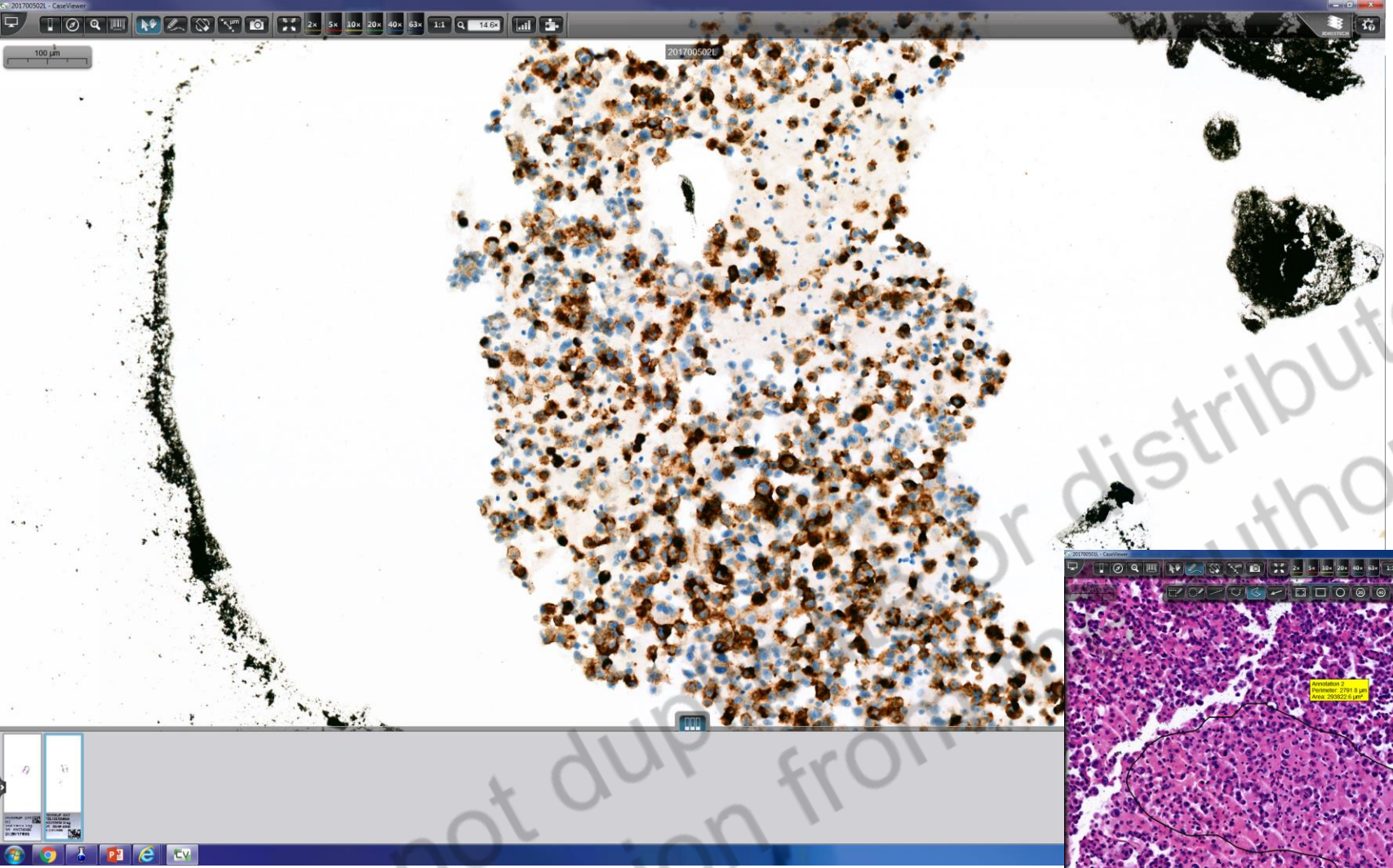
New specimens for grossing

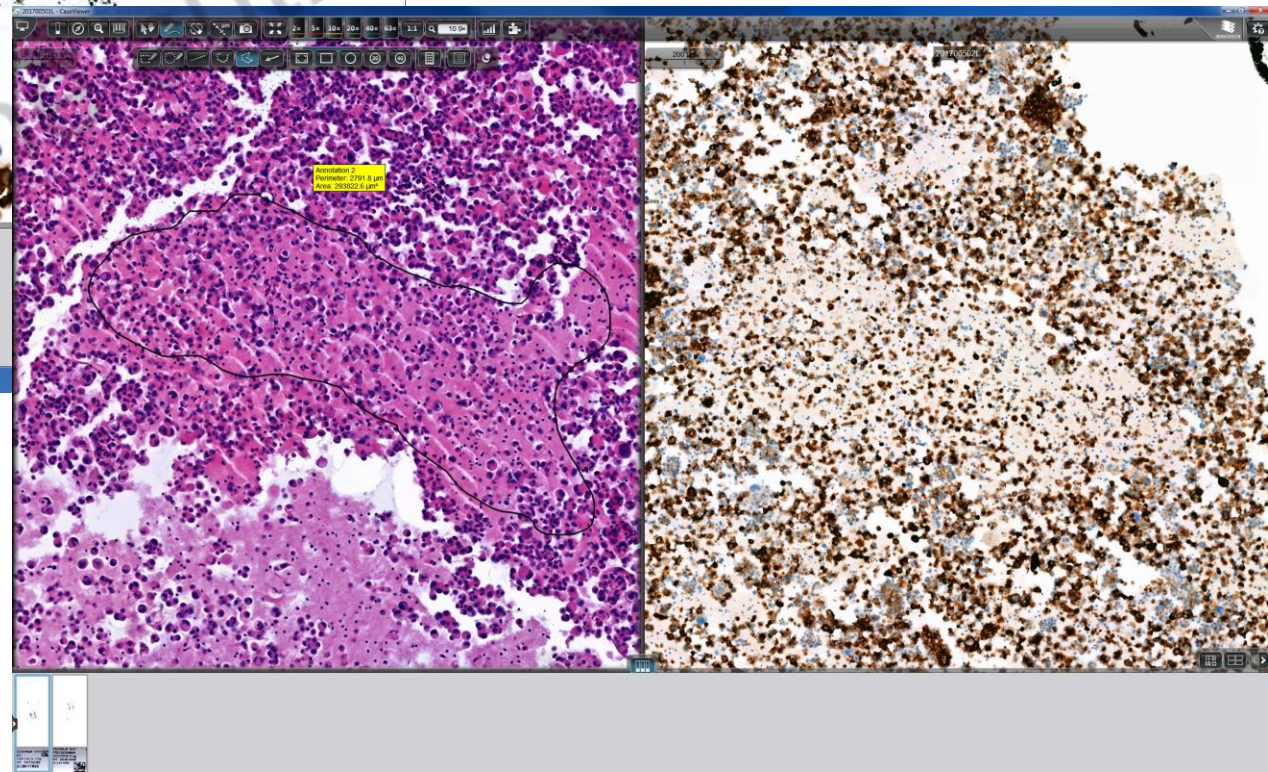
Island for samples management

Ventilated cabinet for samples storage

Change attitude early in the flow - embedding

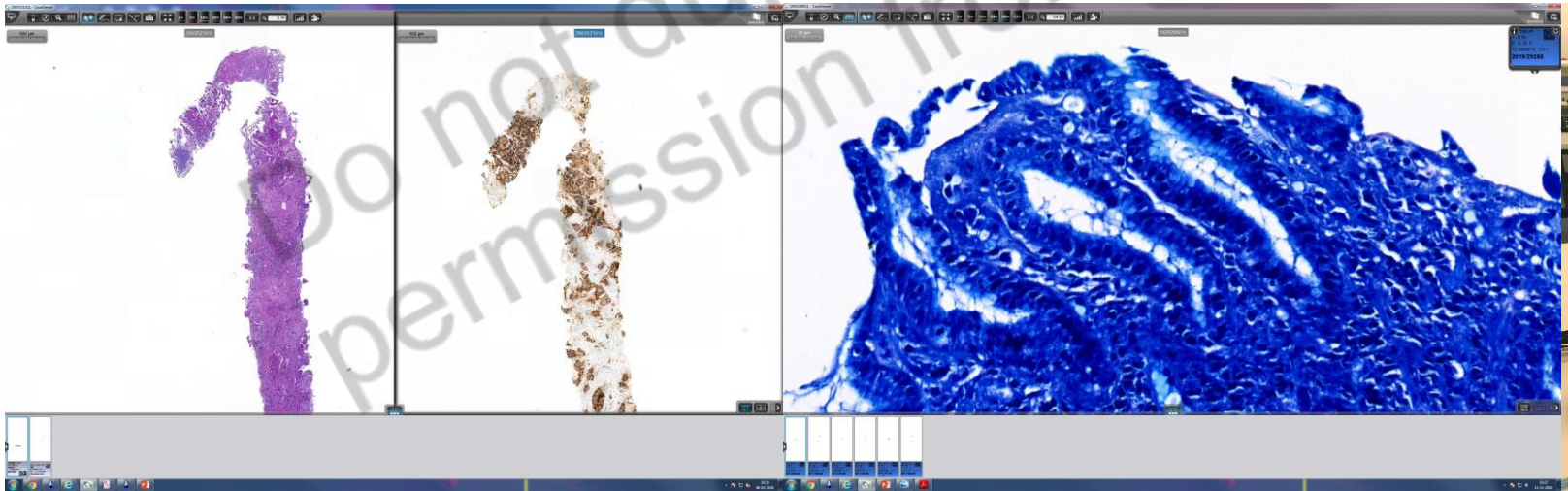
- ✓ Fragments as close as possible to each other and centered on the embedding mold;
- ✓ Always include in such a way as to create less knife resistance to avoid artifacts;
- ✓ Respect the side margins of the embedding mold;
- ✓ One by one.

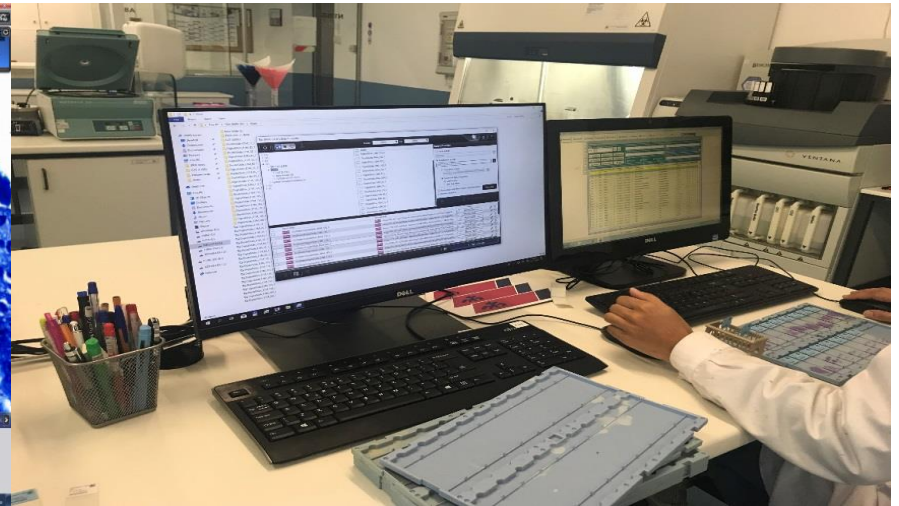




Modifications in the lab work

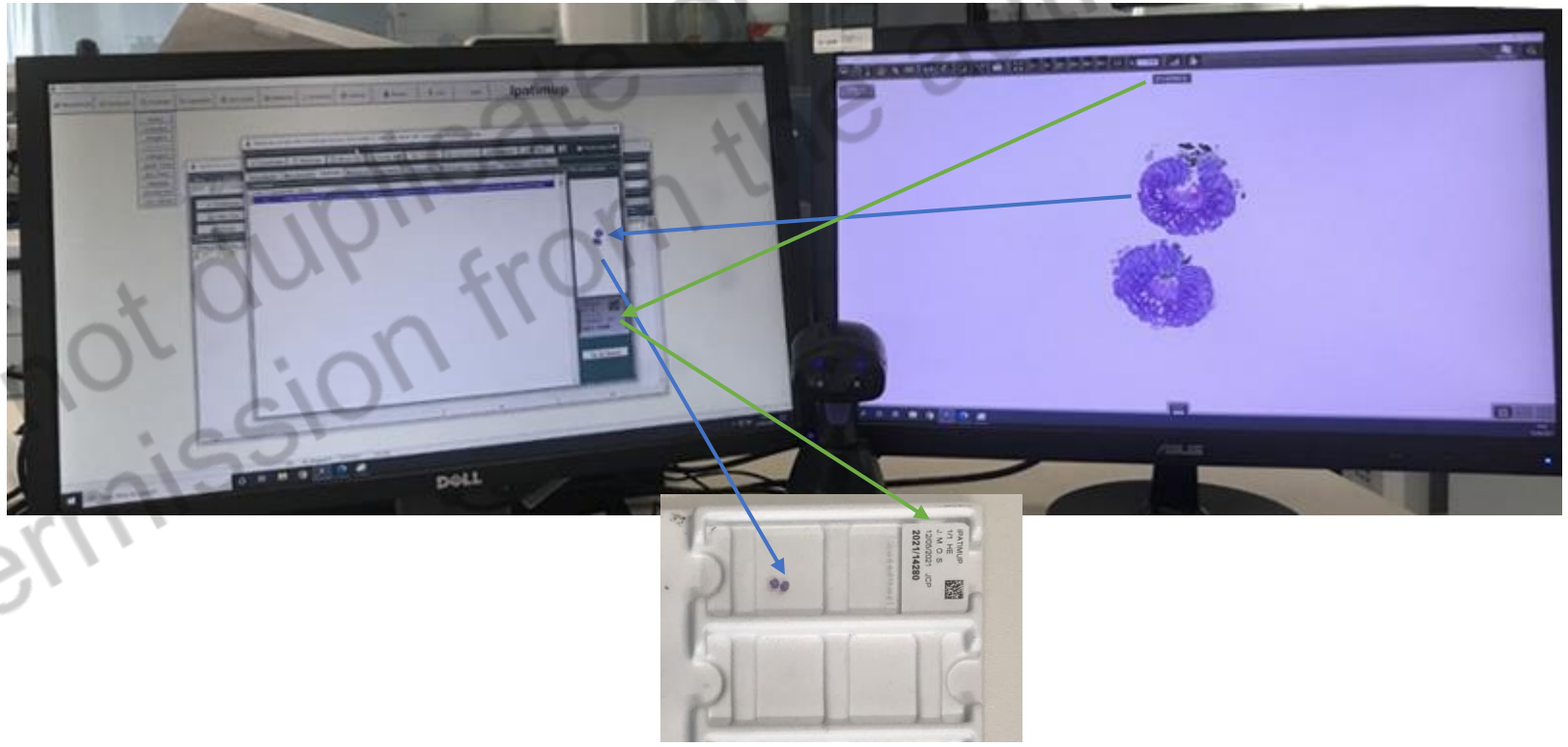
- Adapting to “full charge” schedule keeping with TaT (daily scanning)
- Validated 20x rapid magnification scanning protocol followed by quality control in the screen of the LIS for all scanned slides





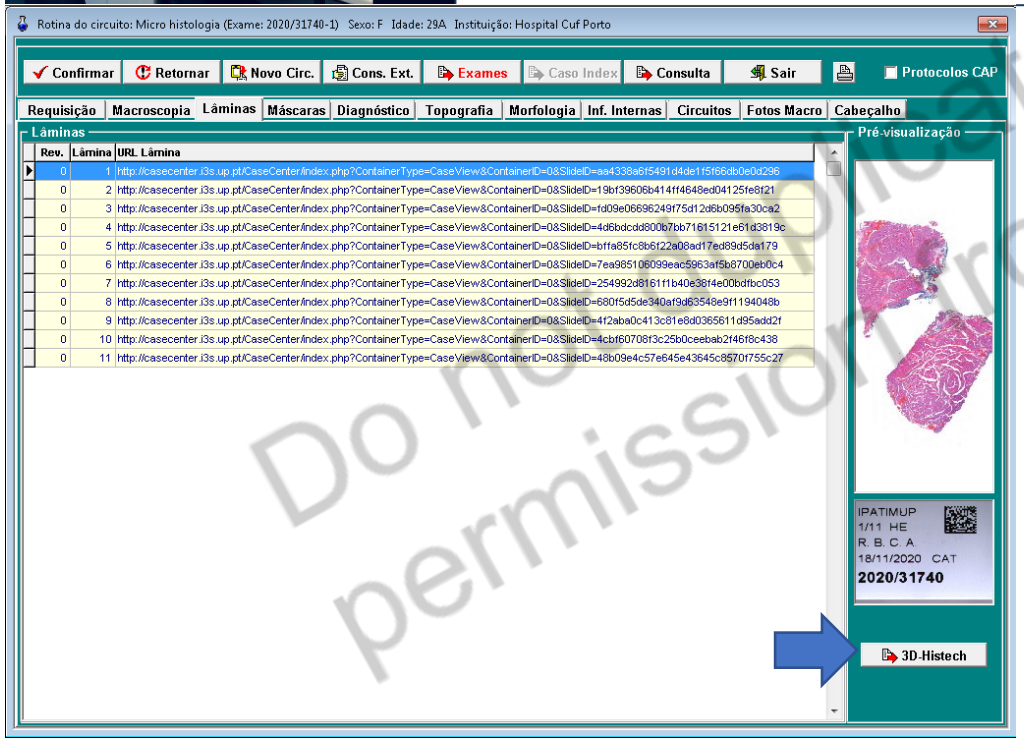
Scanner performance control

- Technical verification of 100% of digital images



1GB network LIS centered

Intel(R) Xeon(TM) Gold 5120 @ 2.20GHz processor, 96GB of memory, a 240GB SSD disk for 64 bit OS, 960GB SSD for SWAP and a 2TB mechanical disk to local storage that gathers the images, convert them and then stores these slides in the CaseCenter server (Intel(R) Xeon(TM) E3-1270 v6 @ 3.80GHz, 24GB of RAM, 2x 240GB SSD for 64 bit OS in RAID 1, and 20TB mechanical disk, from 3DHISTECH).

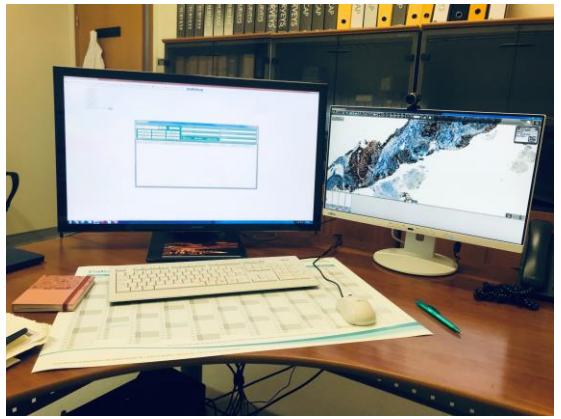


Storage - 220TB storage that can scale up to 960TB (fast and slow disks, images are not erased after diagnosis)

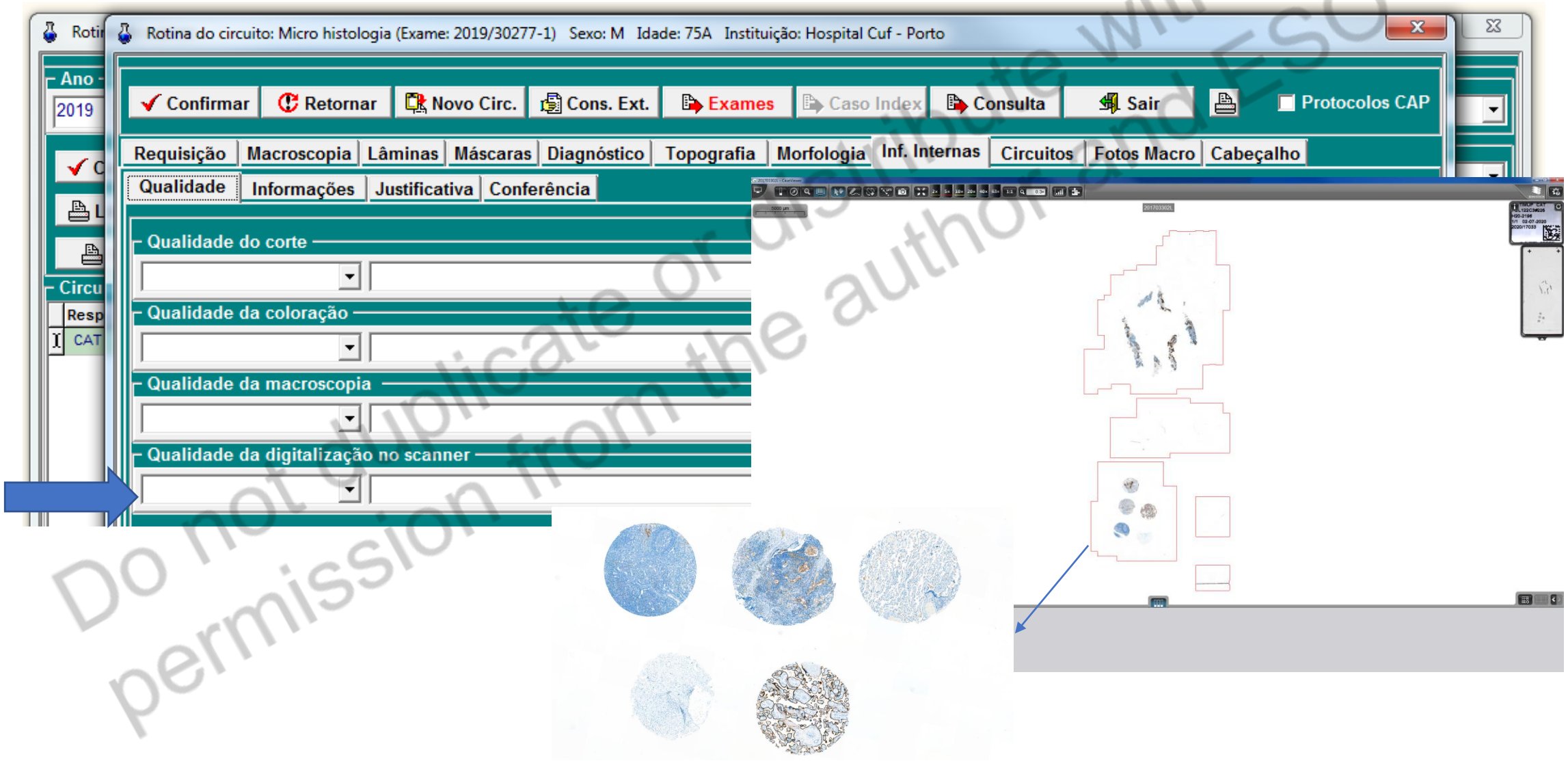
3DHISTECH (viewer) is integrated with LIS (SISPAT)

Dell Precision Tower 3620 equipped with an Intel(R) Core(TM) i7-6700 CPU @ 3.40GHz, 8GB of RAM, ST500DM002-1SB10A ATA Disk with 466GB and a NVIDIA Quadro M2000 with 4GB.

The workstation has two monitors, one Sharp PN-K322BH 4K, 32”, touch screen.

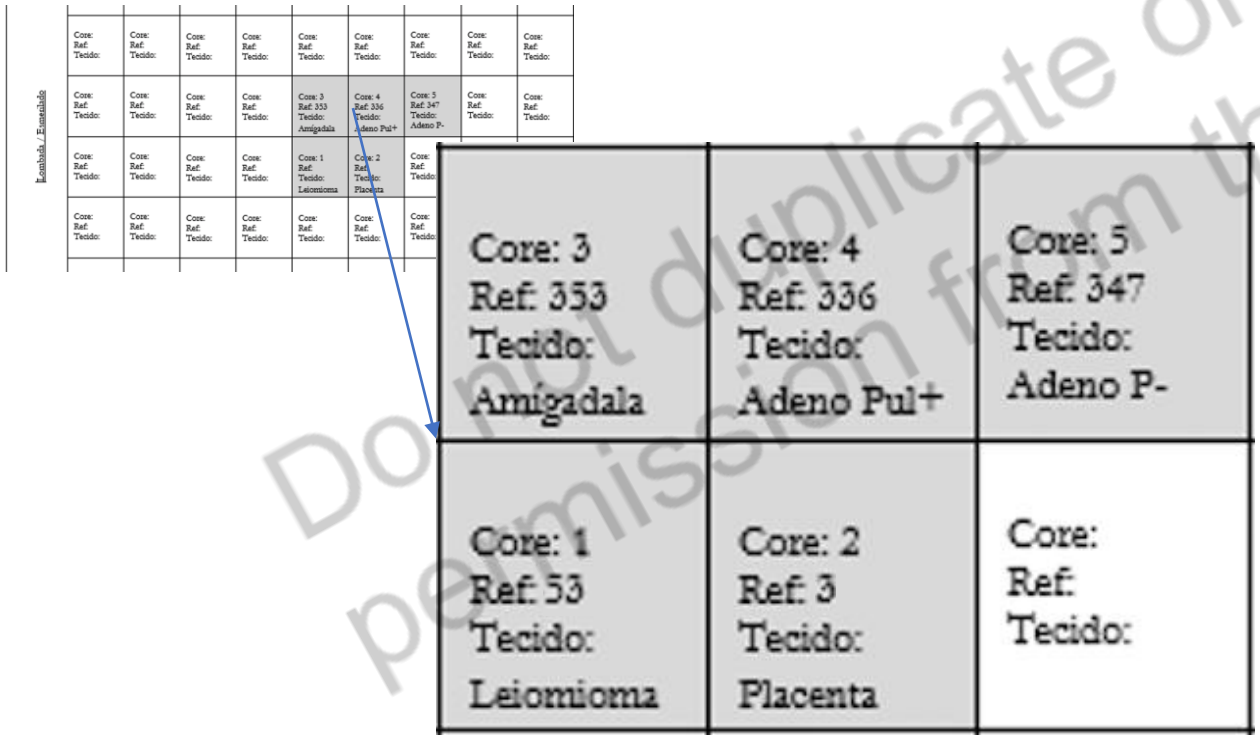


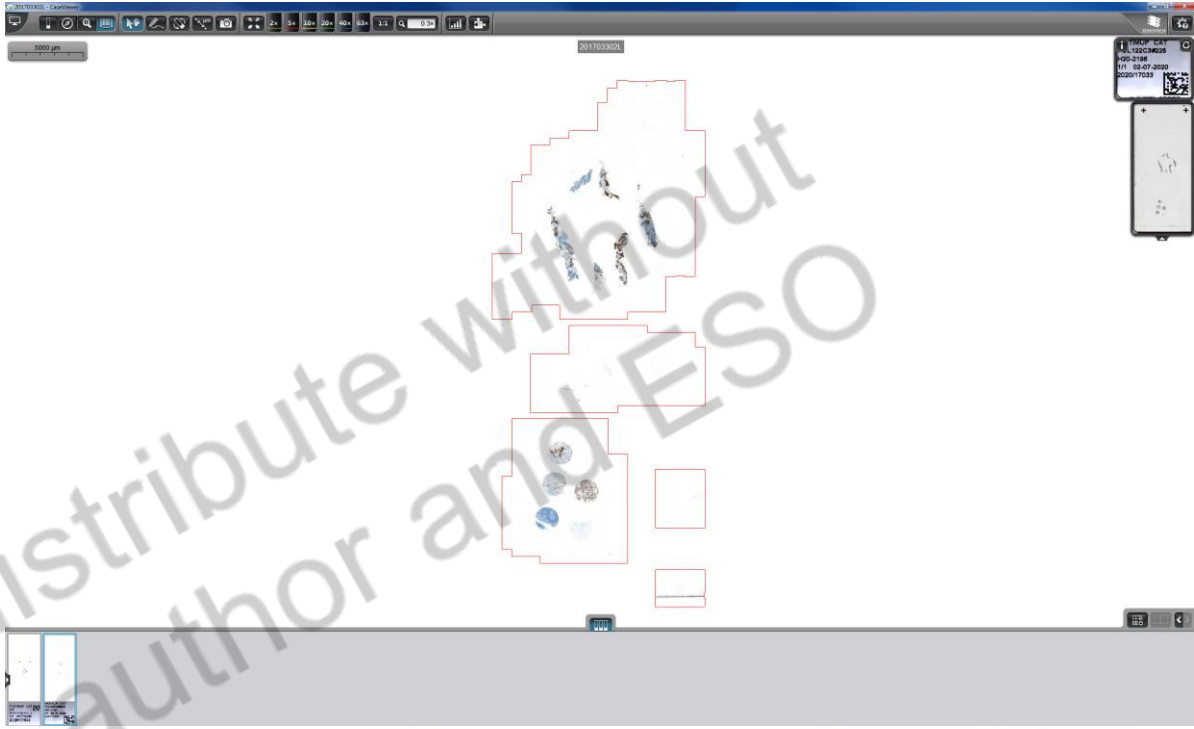
QA program and tissue control bank

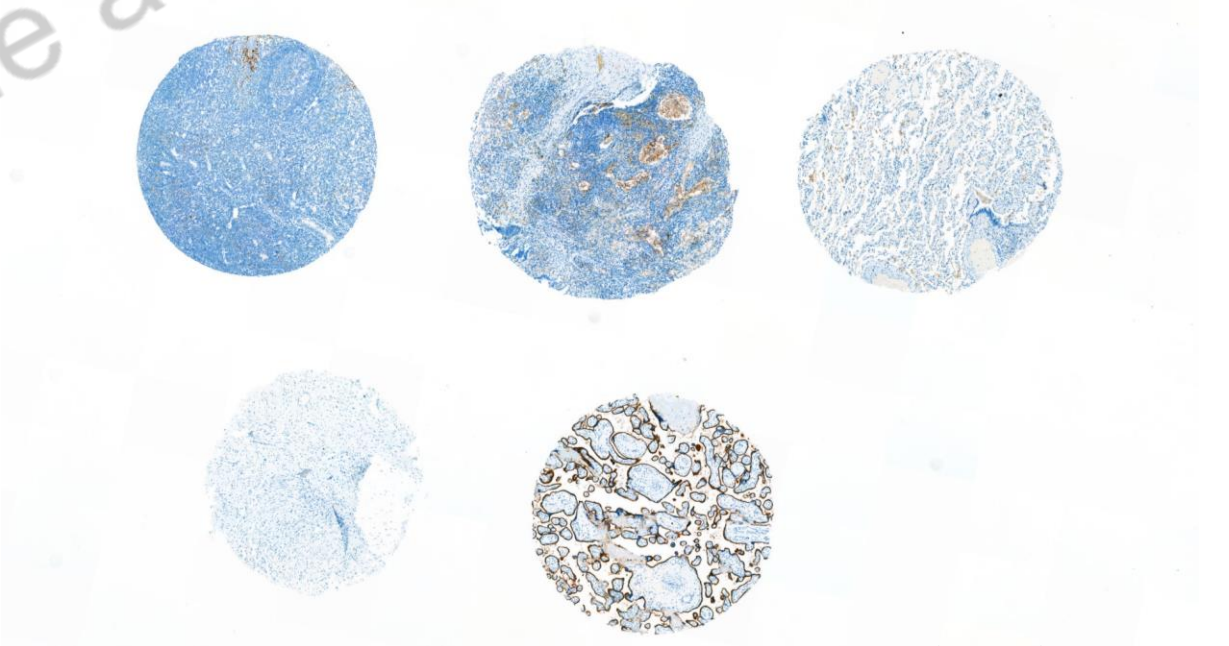


Standardization

Tissue control bank

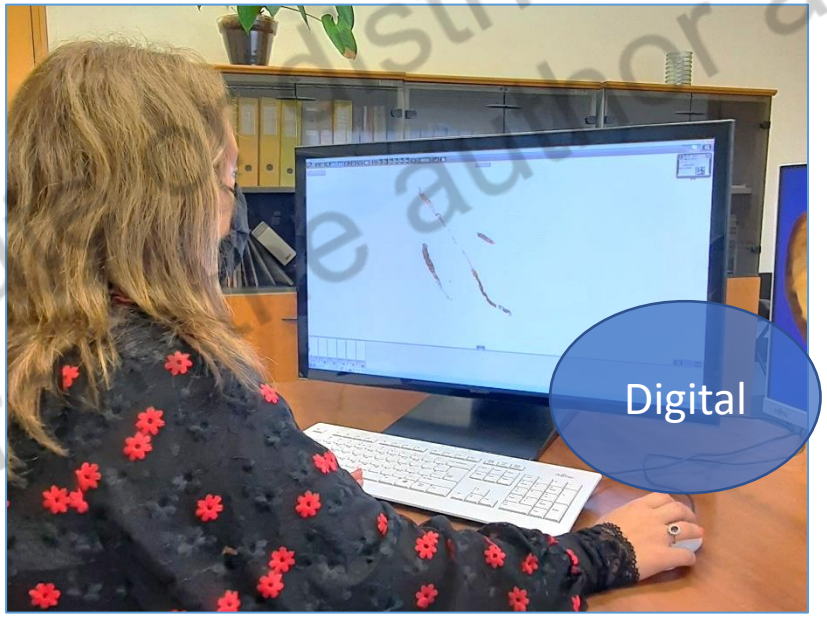






PD-L1 (Lung) TMA

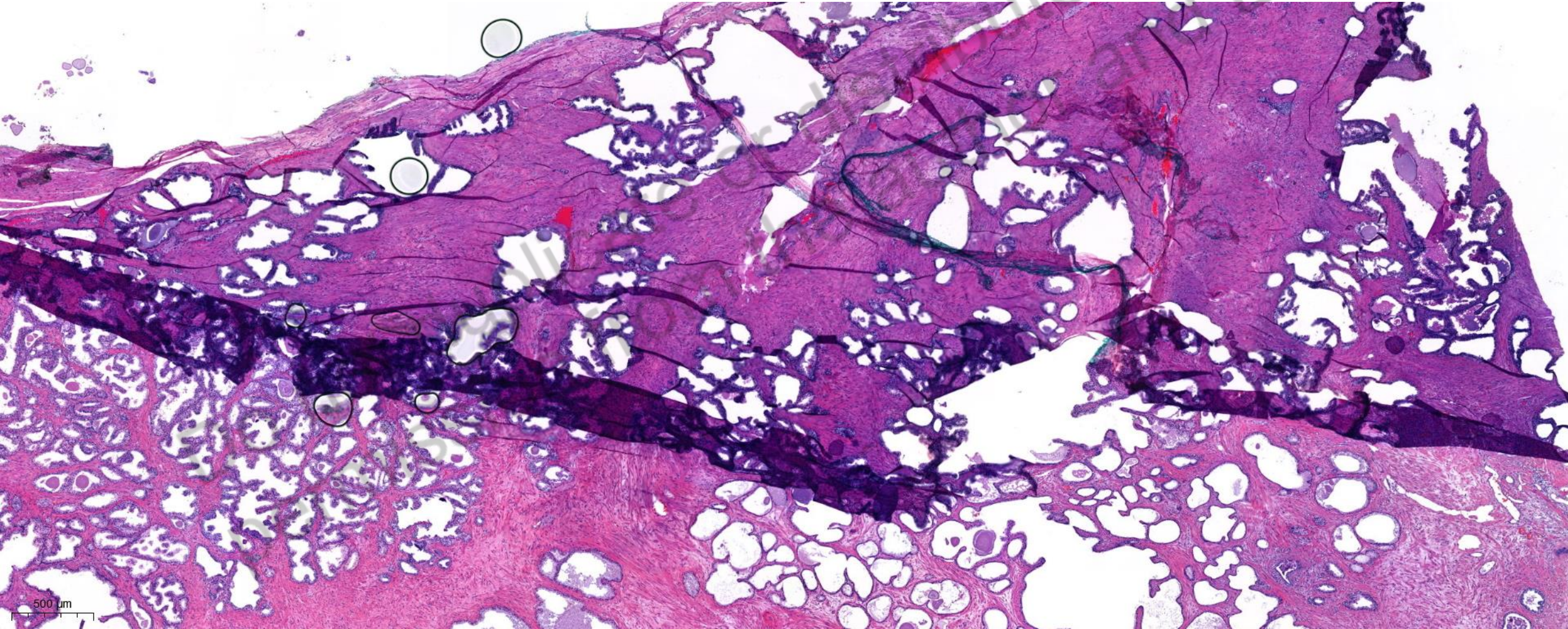
All issues are *amplified* in the digital image



Multilayers and transparency are lost

- Navigation changes
- Ergonomics and environment modifications
- Two tracks' observations (training)
- Quality triage

Artifacts



Results

- Staff

14 pathologists

4 internal/10 external

8 using DP/6 not using DP

Cytology
Consultation cases
Telepathology model
Less than 10 cases/month

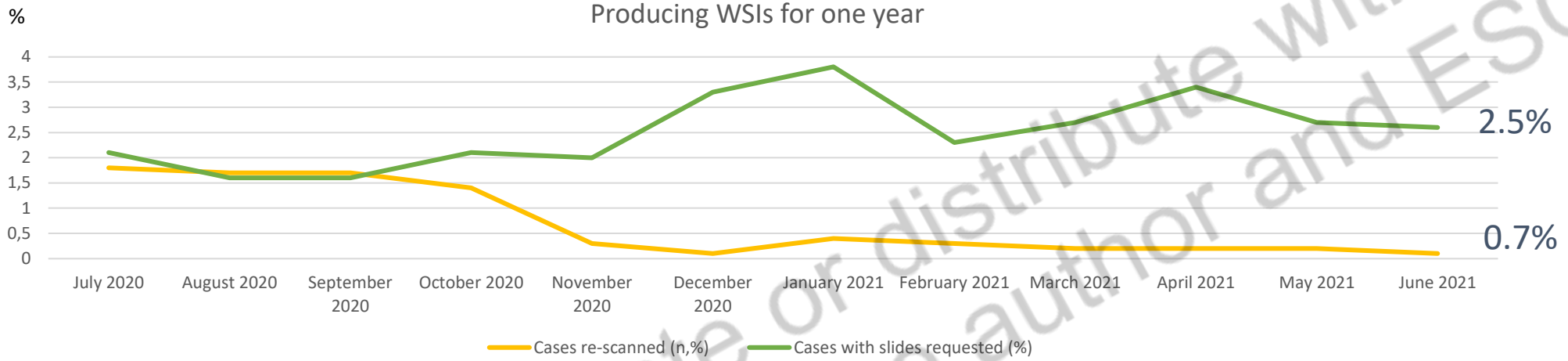
10 technicians

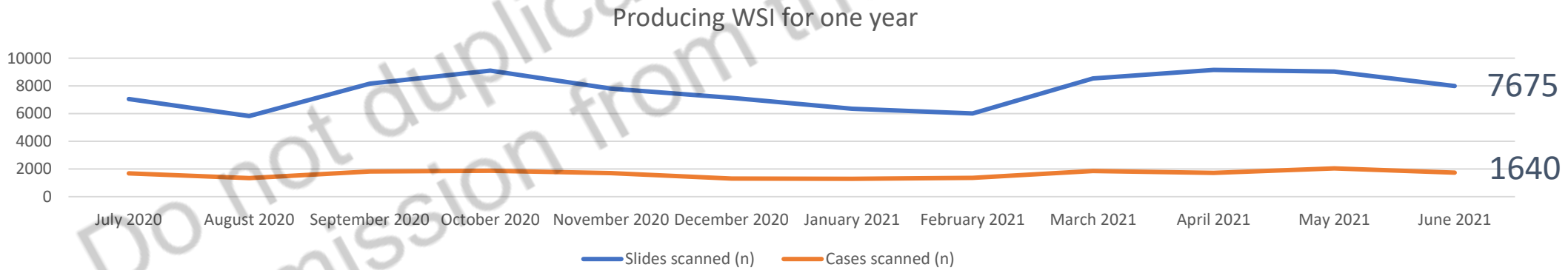
5 administrative

- Production

- 30 000 samples/year
- Paraffin blocks 40 000
- Slides 60 000 (plus external sources)
- Histology, cytology, histochemistry (both types), immunohistochemistry, in situ hybridization (dark and bright field) & immunofluorescence
- Turn around time: 2 days

Results





No impact in the quality of the diagnoses produced (external QA program)
No impact in the quality of the laboratory product (internal QA program) – 98.8% good WSIs
Turn-a-round time was kept after the digital transformation with the same amount of personnel

Adopting the digital workflow

- Choose the scanner
- Validate WSI for clinical usage and optimize the digital navigation for diagnosis
- Establish data retention policies and a digital archive

Validating Whole Slide Imaging Systems for Diagnostic Purposes in Pathology

Guideline Update From the College of American Pathologists in Collaboration With the American Society for Clinical Pathology and the Association for Pathology Informatics

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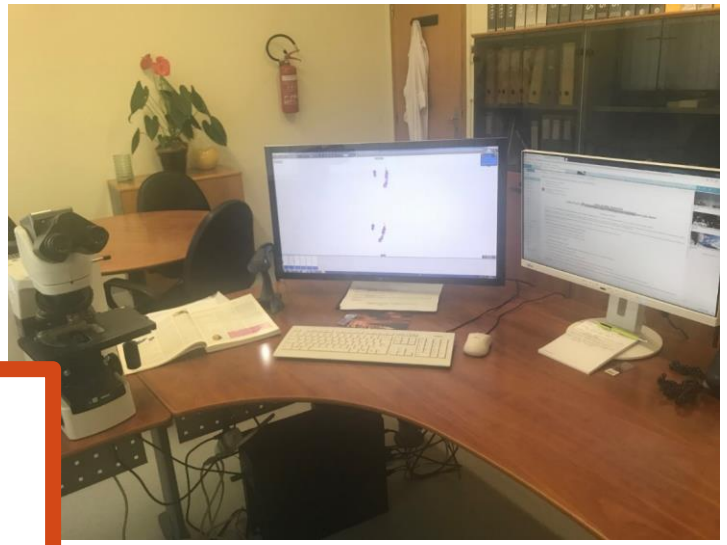
GPS 3. The validation study should closely emulate the real-world clinical environment in which the technology will be used.

GPS 4. The validation study should encompass the entire WSI system. It is not necessary to separately validate each individual component (eg, computer hardware, monitor, network, scanner) of the system or the individual steps of the digital imaging process.



Adopting the digital workflow

- Evaluate the result of the transformation
- Prepare the next step – the digital transformation is just the beginning

The acknowledgement of all data embedded in a simple tissue section stained by haematoxylin-eosin obtained by AI techniques represents a true epistemological transformation

Computed aided diagnostic tools, tools for staging or extracting other morphologically-based prognostic relevant data

Quantification

Am J Clin Pathol. 2020 Oct 29;aqaa151. doi: 10.1093/ajcp/aqaa151. Online ahead of print.

Artificial Intelligence Improves the Accuracy in Histologic Classification of Breast Lesions

António Polónia [1 2], Sofia Campelos [1 2], Ana Ribeiro [3], Ierece Aymore [1 2], Daniel Pinto [4], Magdalena Biskup-Fruzynska [5], Ricardo Santana Veiga [6], Rita Canas-Marques [7], Guilherme Aresta [8 9], Teresa Araújo [8 9], Aurélio Campilho [8 9], Scotty Kwok [10], Paulo Aguiar [2 11], Catarina Eloy [1 2 12]

Research opportunities for understanding the disease - identifying a causal agent of a disease or a pattern of disease

Taxonomy

Algorithms that predict molecular biomarker *status* with relevance to select therapy

Markers

nature medicine ARTICLES https://doi.org/10.1038/s41591-018-0177-5

Classification and mutation prediction from non-small cell lung cancer histopathology images using deep learning

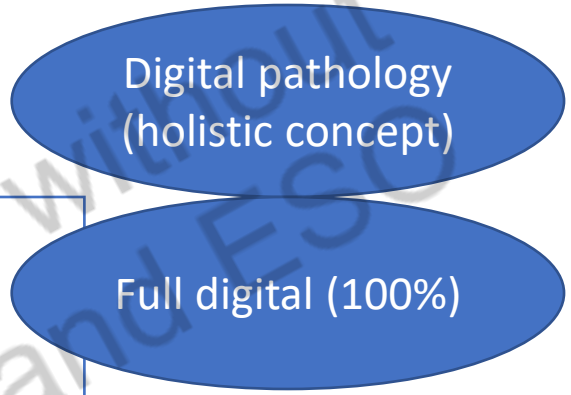
Nicolas Coudray[1,2,9], Paolo Santiago Ocampo[3,9], Theodore Sakellaropoulos[4], Navneet Narula[3], Matija Snuderl[3], David Fenyö[5,6], Andre L. Moreira[3,7], Narges Razavian[8*] and Aristotelis Tsirigos[1,3*]

TABLE 2 | List of the key challenges that face the translation of computational pathology into clinical practice.

Key challenges in diagnostic AI in pathology
Access to large well-annotated data sets
Context switching between workflows
Algorithms are slow to run
Algorithms require configuration
Properly defined protocols for training and evaluation
Algorithms are not properly validated
Lack of health economics

These typically slow down access to diagnostic apps or make pathologists hesitant to adopt. It is critical to ensure that apps are embedded in digital workflows to allow seamless access to AI.

Serag A et al. Front. Med. 2019. 6:185.



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Article | Open Access | Published: 24 June 2021

Quality control stress test for deep learning-based diagnostic model in digital pathology

Birgid Schömig-Markiefka, Alexey Pryalukhin, Wolfgang Hulla, Andrey Bychkov, Junya Fukuoka, Anant Madabhushi, Viktor Achter, Lech Nieroda, Reinhard Büttner, Alexander Quaas & Yuri Tolkach

Modern Pathology (2021) | Cite this article

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ESO-ESP Digital Pathology Seminar

ONLINE COURSE

Porto digital workflow

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