Hunting Unicorns

New Generation Digital Pathology Workflow at the Catalan Health Institute (ICS).

DigiPatICS Project

Institut Català de la Salut

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Generalitat de Catalunya Departament de Salut



Inió Europea ons Europeu e Desenvolupament Regional

The Catalan Health Institute

Institut Català de la Salut (ICS)

Institut Català de la Salut





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The Catalan Health Institute (ICS)

The Catalan Health Institute (Institut Català de la Salut, ICS) is the largest provider for the Catalan Health Service, the insurer of universal health coverage in Catalonia.





Defining the need

The purpose of the project is to increase patient **safety** and **quality** of care, **improving the diagnosis** of tissue and cytological samples and the **efficiency** of the processes in the Pathological Anatomy departments of the ICS, through **Digital Pathology** (DP) and **Artificial Intelligence** tools (IA). It is **transversal**, and will have an impact on the care of patients treated by all medical and surgical specialties.

First conceptual definition of the project







Birth of the DigiPatICS Project

European Regional Development Fund (ERDF) Project

Project for the optimization of anatomopathological diagnosis in a network of public ICS hospitals in Catalonia through digitalization and artificial intelligence tools.



a market consultation was carried out

Tendered with the expedient: "Servicio de digitalización de las pruebas diagnósticas a los hospitales del ICS"

Expedient CSE/CC00/1101202869/20/AMUP

8.414.983,72 €



ender



What do we want?

Increase patient safety and quality of care







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Networking between ICS centers

- Increase patient *safety*, reproducibility and equity of diagnoses.
- Telediagnosis, case sharing and teaching.
- Same LIS & IMP system between hospitals



Improve working conditions

- Improve workflow, *productivity* and response time.
- Improve ergonomics.
- Facilitate tools for **morphometry** and **quantification** of diagnostic and prognostic biomarkers.
- Ergonomic **workstation** design & access all relevant HIS data



Central digital repository

• Store pathology images on the **network**.

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- Decreased workload in *slide* archive management.
- Standardized integration of images in **SIMDCAT** (Digital Medical Imaging System of Catalonia) using **DICOM**.
- Facilitate access to images for decision-making between pathology services and other facilities (operating rooms, interventional exploration cabinets, transplant, or clinical committees) **bidirectionally**.
- Business intelligence and research. Standardization.





Artificial Intelligence

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- Improve the *diagnosis* of tissue samples and the *efficiency* of processes through Digital Pathology and *Artificial Intelligence* tools.
- Develop artificial intelligence algorithms with **Machine Learning and Deep Learning** in order to recognize patterns and select tumor areas, to optimize the reproducibility of diagnoses. Catering to our needs.
- Pre-Deploy IA algorithms to reduce diagnosis time. *Offline* inference.





What can we cover?

- Do we want to save the whole slide images (WSIs) forever? For how long? Who will store them? DICOM?
- Is our laboratory information system (LIS) ready?
- Do we want to (or have to) address pre-analytics?
- Do we want to address dark-field microscopy (direct fluorescence, FISH)?
- Do we want to digitize the macroscopic images?
- Do we need to update the hospital network?
- Do we need to update our pathologists' workstations (PC)?
- Do we want to share cases externally with the outside world?
- Is teaching important?
- Do we want artificial intelligence (AI) algorithms?
- Do we want to do telepathology?
- What do we do with cytology?





L-SIL, ThinPrep (Pap, 115.9x)



What have we achieved so far?

Planning, Scope, and Tender Process

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What have we achieved so far?



Bidding Guidelines

- Tender to be addressed in 4 years (2020-2023)
 + 4 years of maintenance.
- Service oriented.
- The equipment will be the property of ICS at the end of the tender.
- Risk sharing.

Facturación	2020	2021	2022	2023
Fixed percentage	25%	10%		
Variable percentage linked to objectives		5%	5%	5%
Variable percentage linked to activity		10%	20%	20%

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Activity to be addressed

- 1.000.000 slides yearly (∆10-15%).
- 8 hospitals (AR, BE, DT, GT, JX, VC, VH).
- 168 pathologists.



 Biopsies, Frozen sections, Autopsies, Molecular biology, Fluorescence. Routine cytology excluded *(interesting*)

Núm de tècniques	Any 2010	Any 2019	Any 2020	Any 2025	2018-2021
Hospital Ameri de Vilanova de Limita	101.213	105.252	109.310	113.269	428.144
Hospital de Belluñge	231.724	240 990	250 262	259.531	062.810
Hospital Juse 3000	72.007	74.018	77,000	80.681	305.436
Hospital Universital Germans Trias / Pupil	193.802	159.954	166.108	172.284	452.120
Hospital Vall d'Hebron	266.216	276.626	206.433	297,042	1,124.516
Huspital Verpe de la Cinta	36,520	40.08Y	41.002	#3.142	163.325
Hosp. Universitavi Dr. Josep Trueta	125.174	130.181	126.166	140.195	630.738
PitzE Hospital de Vella	2,283	2.374	2,408	2.667	9.680
Total ICS	903,969	1.029.568	1.069.187	1.108.766	4.197.468







What if we adressed cytology?

Digital Pathology Tender CSE/CC00/1101202869/20/AMUP Catalonia, Spain. 2020-2023

8 hospitals -168 pathologists Creation of AI algorithms

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24 scanners (3DH P1000 / 3DH P250)

1.000.000 slides each year histology (Δ10-15%) 400.000 slides each year cytology (Δ10-15%)

 $8.414.983,72 \in +40\%$ in scanners and servers?



European Union European Regional Development Fund









Project amounts

- Tender for 8,414,984.32 \in with VAT included (4 years).
- Within this amount are included:



- With the Polytechnic University of Catalonia BarcelonaTECH (UPC) to develop an artificial intelligence platform and the development of a minimum of 4 artificial intelligence algorithms 508,200 € including VAT.
- With the Center for Telecommunications and Information Technology (Centre de Telecomunicacions i Tecnologies de la Informació, CTTI for the adaptation of the LAN network infrastructures in each of the institutions 582,736 € with VAT included.
- With **IBM** for the development of the new **Laboratory Information System** 240,000 € with VAT included.
- Maintenance by 330,000 €/year with VAT included (4 years).





DigiPatICS in numbers

168 pathologists. 8 hospitals (AR, BE, DT, GT, JX, VC, VH). 24 scanners 13 digital macrophotography stations. 1.082.294 slides/year (2019). ↑ ∆10-15% 1.5 Gb/slide. 2 Petabytes yearly. 8.414.983,72 € New Laboratory Information System LIS (ETPat). Development of Artificial Intelligence algorithms. Image management systems. Teaching platform. Servers, LAN & WAN equipment.





Unicorns?

Specification sheet

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Technical specifications

What we have asked for...





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Technical specifications

... What they will provide us



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Bidding and Contract awarding Candidates and technical tests

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Technical specifications - Award Criteria

• Total: 100 points.

- Automatic evaluation criteria. 51 points
 - Economic valuation. (40 points)
 - Evaluation of the financial offer. (30 points)
 - Evaluation of the maintenance offer. (10 points)
 - Automatic technical evaluation. (11 points)
 - Quality management system. Certification of processes and algorithms. (3 points)
 - Process consulting. (1 point)
 - Image Management Platform adaptations. (3 points)
 - Storage for research slides. (1 point)
 - Short-term "hot" storage (3 points)
- Criteria subject to judgment value. 49 points
 - Scanners: deployment and image quality. (17 points)
 - Diagnostic viewer. (8 points)
 - Image Management Platform. (4 points)
 - Training module. (2 points)
 - Built-in tools and algorithms. (3 points)
 - Architecture and monitoring. (1 points)
 - Long term storage in SIMDCAT. (4 points)

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- Integration of case information in a unified model. (2 points)
- Server infrastructure requirements and DPCs. Coherence, management model, virtualization. (2 points)
- Workstations. (2 points)
- Artificial intelligence. (3 points)
- Implementation and additional improvements. (1 points)





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Bidding companies

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Scanners



Technical tests

Viewers and IMP



We prepared a test that had never been done at ICS... More than 9.000 real slides tested 5 days 24h of routine













Contract awarding

- Best deployment proposal of *servers* (DPC in each hospital and inference servers and AI training).
- Best *scanner* deployment proposal (speed, scanning capacity, image quality).
- Best Image Management Platform.
- Best workstations.
- Better *tools* to support pathologists and algorithms with IVD certification.





Palex 📚

Constant Improvement 3DHISTECH

What is DigiPatICS?

How are we going to achieve the Digital Pathology Transformation

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de la Salut

24 Scanners

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P1000 BF DS P300-P250 BF FL Scan II (150) BF FL

Include both BF and FL. High resolution capability (non routine mode).

High throughput.

Result images have "good quality" (pathologist perception).

- Scanner routine reliability.

Low scanning time

High scanner number.



Scanners – High Throughput

1.000 Slides 800 Slides + 40 Double Slides Sakura4768 Magazines: 20 Objectives 20x & 40x + Immersion Resolution 0,12 μm/pixel & 0,24 μm/pixel

Bright Field and double slides







3DHistech

Scanners - Fluorescence

300 Slides Magazines: 25 Objectives 20x & 40x Resolution 0,12 μ m/pixel & 0,24 μ m/pixel

Fluorescence and bright field

3DHistech



150 Slides Magazines: 25 Objectives 20x & 40x Resolution 0,09 μ m/pixel & 0,16 μ m/pixel

Fluorescence and bright field





3DHistech





Scanners deployment

















Digital macrophotography stations 13 MacroPATH QX











Workstations

Equipment	Units
Total Workstations	183
Total 32" Monitors	286
Total 55" Monitors	6
Total Projectors	7





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IMP Diagnostic Viewer

IVD support algorithms

Telepathology

Teaching module









HES Anatomia Service



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Software – What we demand

- Open to standards
 - Accomplish Corporate requirements.
 - ICS Information systems philosophy.
 - DICOM compliance.
- Open to different IA solutions
- User friendly
 - Only one solution/viewer for:
 - Bright-Field, Fluorescense, Double Slide, Algorithms.
 - Complete features available.







Network Needs

LAN WAN DPCs AI

Design of the IT infrastructures is one of the biggest parts of the project, this has become the most difficult part so far,....

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Telepathology and networking

Teleconsultation: Synchronous – Shared screen. "Virtual multihead microscope". **Asynchronous** – Sending the case to another expert.





Artificial Intelligence

Universitat Politècnica de Catalunya (UPC) – BarcelonaTech

Institut Català de la Salut







Next steps?

How are we going to achieve digitalization of pathology?

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Next steps?

Communication and accompaniment to change







Halfway There

5



Some numbers

(Nov21 - Oct22)

- Number of cases: 205,267
- Number of scanned slides: 408,923
- Used space: 0.4 PetaByte
- GB per slide: 0.96 GigaByte/Slide





Generalitat de Catalunya Departament de Salut

Partnership Public – Private collaboration

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Partnership – What we demand

- Flexibility
 - Capability to adapt the solution in non long term road maps.
 - A project as big as this always has surprises, we need a travel companion who knows how to adapt.
- Quality
 - Good products + Good understanding of our needs
 - Long term partnership with constant evolution.
- Risk sharing / commitment
 - You really believe in our project? Prove it!





Work groups

Teams

. . .

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Al teams Network teams (LAN and WAN) Scanners team New workstation development Process group SIMDCAT integration team DICOM Pathology departments IT Teams Logistics SHIT



HAPPENS



Take Home Messages

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DigiPatICS in numbers

168 pathologists. 8 hospitals (AR, BE, DT, GT, JX, VC, VH). 24 scanners 13 digital macrophotography stations. 1.082.294 slides/year (2019). ↑ ∆10-15% 1.5 Gb/slide. 2 Petabytes yearly. 8.414.983,72 € New Laboratory Information System LIS (ETPat). Development of Artificial Intelligence algorithms. Image management systems. Teaching platform. Servers, LAN & WAN equipment.





Take home messages

- > We are looking for **safety**, **equity** and **fairness** in the treatment of patients.
- > We are looking for a *complete* solution for Pathology departments.
- The change of *information systems* and *infrastructures* is a key element in this type of project.
- We need to look for tools that help pathologists do their job with AI algorithms developed by us. We will have an image repository to train CNN's - Deep Learning.
- We are looking for *networking*, which allows us to *share* the *knowledge* of our professionals.
- > The digitization of Pathology is a *technological*, *organizational* and *functional challenge*.
- > Integration of cytohistological, clinical, radiological and molecular information.
- ➢ Digital Pathology → Computational, Holistic and Integrative Pathology





> Diagnostics (Basel). 2022 Mar 30;12(4):852. doi: 10.3390/diagnostics12040852.

DigiPatICS: Digital Pathology Transformation of the Catalan Health Institute Network of 8 Hospitals-Planification, Implementation, and Preliminary Results

Jordi Temprana-Salvador ¹, Pablo López-García ², Josep Castellví Vives ¹, Lluís de Haro ², Eudald Ballesta ², Matias Rojas Abusleme ³, Miquel Arrufat ⁴, Ferran Marques ⁵, Josep R Casas ⁵, Carlos Gallego ⁶, Laura Pons ⁷, José Luis Mate ⁷, Pedro Luis Fernández ⁷, Eugeni López-Bonet ⁸, Ramon Bosch ⁹, Salomé Martínez ¹⁰, Santiago Ramón Y Cajal ¹, Xavier Matias-Guiu ¹¹ ¹²

Affiliations + expand PMID: 35453900 PMCID: PMC9025604 DOI: 10.3390/diagnostics12040852 Free PMC article



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