Cloud ARtificial Intelligence For pathologY

SECOND NEWSLETTER – Sep 2021

Welcome to the second newsletter!

CLARIFY is almost two-year-old, and, despite the COVID-19 pandemic, we have made good progress towards our project goals. With this newsletter our public will be informed about the last outcomes of the CLARIFY project, including scientific results, events, dissemination actions, secondments, training activities, etc.

CLARIFY has reached its first milestones during this period and will definitely improve our knowledge about how new technologies like artificial intelligence (AI) and cloud computing can maximize the benefits of digital pathology and aid pathologists in their daily work.

Visit our webpage: www.clarify-project.eu

CLARIFY in a nutshell


4 universities


2 companies


4 years duration
Nov,19 - Oct,23


3 hospitals


12 Early Stage Researchers (ESR)

Milestones achieved

In the first 2 years of the project, despite having to adapt the initial project plan because of the COVID-19 outbreak, all the milestones foreseen have been achieved: meetings, deliverables, training, ESRs enrollment, scientific publications, event organization...

- 15 project meetings among the whole CLARIFY consortium (supervisory board and follow-up meetings).
- Monthly work-package meetings .
- Biweekly/monthly organ-specific cancer meetings.
- Monthly ESR meetings.
- Enrollment of the 12 ESRs, all of them working onsite.
- 20 deliverables submitted.
- 3 milestones completed.
- First progress report submitted.
- 1 big training event & 2 Virtual Fieldtrips.
- External Advisory Board supervision.

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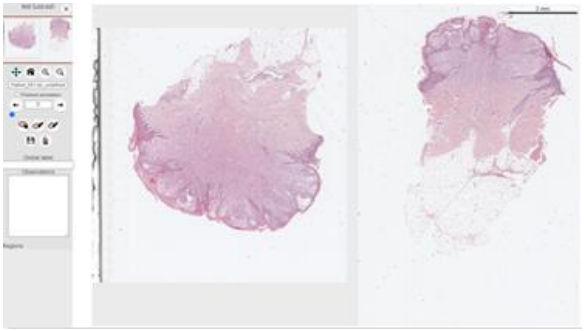
This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska Curie grant agreement No 860627

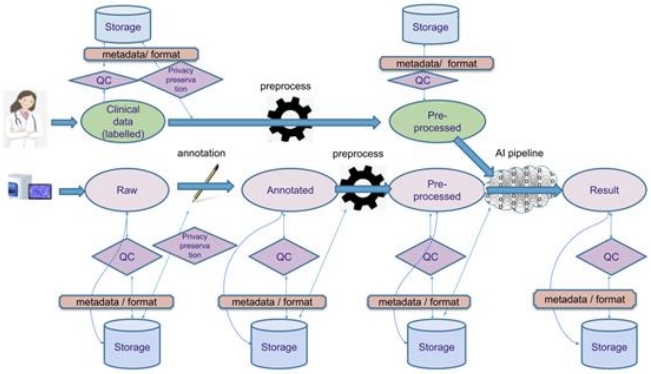
Scientific Deliverables

D4.1 Annotation Tool

The purpose of D4.1 is to introduce a user-friendly web-based application that allows histological image navigation and annotation by experts. It is particularized to be used for the different cancer types under study in CLARIFY.



Interface of the web application



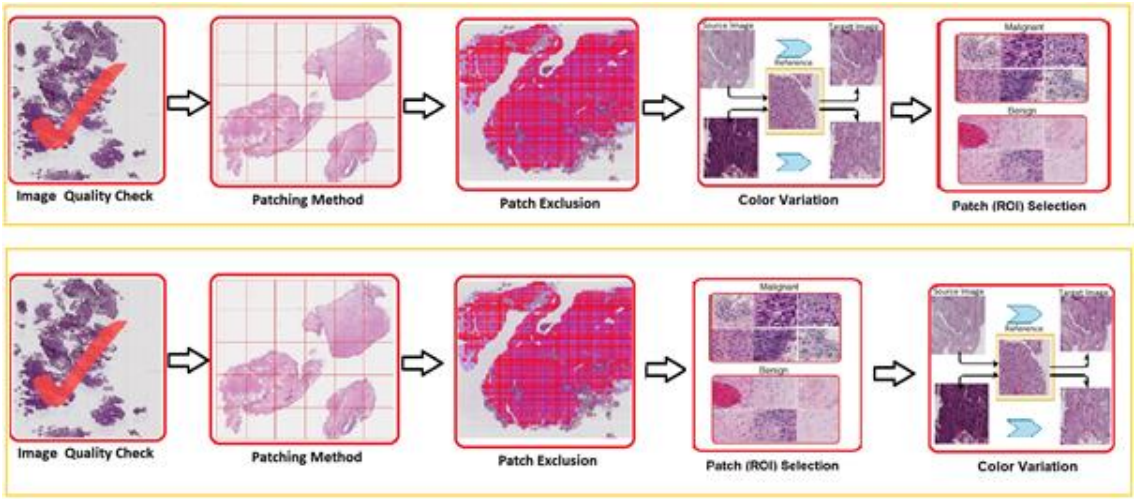
Generic dataflows of whole slide images and clinical data in WSI-based research

D2.1 Metadata Standardization Strategy and Database

D2.1 aims to present the metadata standardization strategy based on the metadata requirements of CLARIFY and state-of-art metadata standards. It analyzes the possible research assets within the data flow and collects the metadata requirements for each type of research asset. Recommendations and a plan are given on the top of gap analysis between the requirements and the state of arts.

D3.1 WSI Preprocessing and Standardization Protocol

D3.1 presents techniques useful for preprocessing and standardization of Whole Slide Images (WSIs), focusing on the three example diseases in CLARIFY. It defines methods to process images that ensure a minimum quality level, read different microscopy scanner formats, color normalization, and identify relevant areas to facilitate subsequent analysis. It summarizes various aspects of image processing techniques applied to Hematoxylin and Eosin (H&E) patches.



Possible pipelines to process WSIs

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ESR project updates

ESR1: Na Li, Universiteit van Amsterdam: *"Semantic interoperability of digital pathology data via common formal terminology"*

- Participated in the 2020 International Semantic Web Conference (ISWC), where she had the chance to meet (virtually, though) the community and get to know the state of art in the domain of semantic web.
- Participated in the secondment at Helse Stavanger HF (SUH), where she was provided with knowledge about quantitative pathology through online lectures and case discussions.
- Finished the Deliverable 2.1 entitled "Metadata Standardization Strategy and Annotated Database", which describes the requirements for standardization strategies, annotated databases and proposes recommendations.
- Focused on research asset discovery, which has been decomposed as dataset search and code search. She tends to approach both questions by leveraging technologies from multiple domains such as information retrieval, natural language processing and semantic web.

ESR2: Yuandou Wang, Universiteit van Amsterdam: "*Seamless trusted data sharing techniques*"

- Data sharing techniques-related knowledge acquisition to be able to develop seamless trusted data sharing approaches.
- Technology exploration on managing distributed workflows in the Jupyter Notebook environment to be able to improve the performance bottlenecks of future AI pipelines.
- Literature study on the topic of "decentralized workflow management on software-defined infrastructures: Research challenges, surveys, and future directions" to enlighten our ideas with critical insights.

ESR3: Jiahui Geng, bitYoga AS: "*Taking computation to Data: integrating BigData and Blockchain allowing secure analysis of sensitive health data on-premise*"

- One paper accepted by Second Blockchain Software Engineering Workshop at EASE2021: "DID-eFed: Facilitating Federated Learning as a Service with Decentralized Identities"
- One paper accepted by Workshop on Parallel, Distributed and Federated Learning at ECML-PKDD 2021: "Optimized Federated Learning on Class-biased Distributed Data Sources"
- Finished the Deliverable 6.4: CLARIFY Repositories for Open Access.
- Finished the secondment at the University of Amsterdam on open infrastructure for federated computation

ESR4: Neel Kanwal, University of Stavanger: *"Preprocessing, segmentation and anonymization of WSI"*

- Contributed to formulate bladder dataset with ESR5 and ESR10 for different future uses.
- Attended a secondment at SUH to understand digital pathology workflow and clinical knowledge necessary for training models.
- Reviewed various approaches in literature to understand better preprocessing and standardization of WSIs and wrote a deliverable D3.1 as part of WP3.
- Co-authored a conference paper with ESR3 on Decentralized Identified for federated learning at EASE2021.
- Presented abstract at NOBIM 2021 Conference (Norwegian Association for Image Processing and Machine Learning) held at Oslo Gardermoen.
- Working with Gaussian process for the application of artifact detection in UGR secondment.

ESR5: Saul Fuster Navarro, University of Stavanger: *"Extracting diagnostic and prognostic information from histological images of NMIBC"*

- Preparation of the HR-NMIBC dataset from EMC along with ESR10 (Farbod Khoraminia), for which an annotation protocol was defined.
- Secondment at EMC to gain expertise in the domain of bladder cancer and histopathology to better understand the clinical problem and how to solve with adequate AI models.
- Participated in NOBIM conference in Oslo to present an ongoing research in weakly supervised learning and interpretability.
- Developing novel AI models for image processing related tasks inspired from real-world WSI processing and extracting regions of interest.

ESR6: Claudio Fernández - Universitat Politècnica de València: *"Significant feature extraction from WSI for diagnosis and prognosis of TNBC"*

- Participation in a secondment at ROCHE in which professionals from ROCHE and other doctors introduced relevant technical information more specifically about breast and lung cancer.
- Host of the Triple Negative Breast Cancer (TNBC) CLARIFY Meetings, with our international TNBC Team from SUH, UGR, UiS and UPV. These meetings are fundamental for coordination.
- Together with Umay Kiraz (ESR11), development of an Annotation Protocol for TNBC images so that they are suitable for future processing and use for training and testing Deep Learning models.
- Training and testing a Convolutional Neural Network based on UNet architecture for detecting and segmenting mitoses using the WSIs previously annotated by ESR11 based on the TNBC Annotation Protocol.

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ESR7: Laëtitia Launet - Universitat Politècnica de València: *"Deep learning for spitzoid melanocytic lesion (SML) characterization"*

- Preparation of the Spitz tumors dataset, in collaboration with ESR12 (Andrés). Preparation of patches and the data that will be needed for future AI approaches.
- Clinical and pathology-related knowledge acquisition to be able to develop and define optimal AI models, as well as interacting more efficiently with pathologists. Secondments at ROCHE and INCLIVA
- Participated in the writing of a book chapter about AI for digital and molecular pathology, for the Fundación Universitaria de Ciencias de la Salud (FUCS) in Colombia with ESR12.
- Research and development of AI models to try to mimic the steps pathologists undertake when analyzing a biopsy, making use of innovative techniques such as self-training.

ESR8: Arne Schmidt - Universidad de Granada: *"Probabilistic large scale crowdsourcing methods for histological image classification"*

- During the first year of the PhD programme, ESR8 got familiar with digital pathology, probabilistic deep learning models, active learning, crowdsourcing and multiple instance learning. In collaboration with the UPV, an article about multiple instance learning is currently under review.
- ESR8 completed a virtual secondment of three months at the University of Stavanger. During the stay, the deliverable D3.1 "WSI Preprocessing and Standardization Protocol" was completed in collaboration with Neel Kanwal (ESR4, UiS) and Fernando Pérez Bueno (UGR).
- The paper of ESR8 was accepted for MICCAI 2021: "Combining Attention-based Multiple Instance Learning and Gaussian Processes for CT Hemorrhage Detection" (Yunan Wu, Arne Schmidt, Enrique Hernández Sánchez, Rafael Molina, and Aggelos K. Katsaggelos)

ESR9: Zahra Tabatabaei - Tyris Software S.L.: *"Strategies for cloud-based histological image retrieval"*

- Analyzing and coding different AI models in the field of Content- based Image Retrieval (CBIR) to simulate the pathologists' strategy to diagnose cancer and consult about them based on tissue analysis.
- Passing her first secondment at INCLIVA to gain more knowledge about skin cancer and especially on spitzoid cancer, which is one of the main cancer types in the scope of her thesis.
- Attending a summer school (Beyond AI), led by Graz University of Technology (TU Graz) and virtual vehicle Research GmbH .

ESR10: Farbod Khoraminia - Erasmus Medisch Centrum Rotterdam: *"Improving HR-NMBC diagnosis and prognosis by digital pathology"*

- Making pathological slides from high risk non-muscle invasive bladder cancer (HR-NMIBC) samples collected from five different hospitals.
- Scanning the pathological slides and preparing the scans in order to create the HR-NMIBC dataset.
- Obtaining the certificate of the basic course on regulations and organization for clinical researchers (BROK). This certificate is compulsory for all clinical researchers that are involved in medical, scientific research.
- Writing a systematic review (in the editing phase) entitled: "Current status of artificial intelligence for bladder cancer pathological image analysis: A systematic review".
- Obtaining bladder cancer clinicopathological knowledge in order to acquire an appropriate perspective for performing the project.

ESR11: Umay Kiraz - Helse Stavanger HF: *"Evaluation of TNBC for diagnostic and prognostic by digital pathology"*

- Preparation of the triple negative breast cancer (TNBC) dataset, identification prognostic features, classification of TNBC subgroups and participation in several courses to improve the knowledge about digital pathology.
- Preparation and elaboration of the TNBC annotation protocol in collaboration with Claudio Fernández (ESR6, UPV) and annotation of the relevant features of TNBC WSIs according to protocol.
- Working together with the non-muscle invasive bladder cancer team of CLARIFY Project for bladder cancer annotations.

ESR12: Andrés Mosquera-Zamudio - Instituto de Investigación Sanitaria INCLIVA: *"Analysis of the implementation of AI algorithms in the evaluation of spitzoid melanocytic tumours for diagnosis and prognosis"*

- Spitz tumors database with almost 200 tumors including clinical and histopathological variables.
- Spitz tumors WSI scanning and annotations.
- Book chapter of digital and molecular biology using AI for the Fundación Universitaria de Ciencias de la Salud (FUCS) in Colombia with ESR7.
- Online presentation for the Colombian association of Pathology (ASOCOLPAT) "Deep learning for pathologists".
- Acquisition of more Spitz images in Colombia (work in progress).

Visit the CLARIFY's blog to know the motivations, aspirations and achievements of our ESRs: www.clarify-project.eu/from-clarify-to-the-world/

What's happening?

 4 conference papers

 1 journal paper

 8 Secondments

 9 local training activities

 2 network training activities

- **Scientific publications**

CONFERENCE PAPERS

HPCS 2020: International Conference on High Performance Computing & Simulation (22-27 March 2021; Online)

Kruijer W., Wang Y., Koulouzis S., Li N., Bianchi R., Zhao, Z.: FAIR-Cells: an interactive tool for enabling the FAIRness of code fragments in Jupyter notebooks, in the proceedings of international conference of High Performance Computing and Simulation (HPCS) (2020), Spain [to appear]

Researchers nowadays often rapidly prototype and share their experiments using notebook environments, such as Jupyter. To scale experiments to large data volumes, or high resolution models, researchers often employ Cloud infrastructures to enhance notebook (e.g. Jupyter Hub) or execute the experiments as a distributed workflow. In many cases, a researcher has to encapsulate fragments of the code (namely cells) from the notebook as components to be included the workflow. It is time consuming and a burden to researcher to encapsulate those components based on specific interface required by the workflow systems. The findability, accessibility, interoperability and reusability (FAIR) of those components are often limited. We propose and develop FAIR-Cells, a tool that can be integrated into the Jupyter environment to help scientists to improve the FAIRness of their code by creating the selected code as RESTful services, containerizing the services, and publishing the containers in the community catalogue using required metadata.

ECML-PKDD 2021: European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases (13-17 September 2021; Online)

Yongli Mou, Jiahui Geng, Sascha Welten, Chunming Rong, Stefan Decker, and Oya Beyan, Optimized Federated Learning on Class-biased Distributed Data Sources. 4th Workshop on Parallel, Distributed and Federated Learning at ECML-PKDD 2021.

Due to privacy protection, the conventional machine learning approaches, which upload all data to a central location, has become less feasible. Federated learning, a privacy-preserving distributed machine learning paradigm, has been proposed as a solution to comply with privacy requirements. By enabling multiple clients collaboratively to learn a shared global model, model parameters stead of local private data will be exchanged under privacy restrictions. However, compared with centralized approaches, federated learning suffers from performance degradation when trained on non-independently and identically distributed (non-i.i.d.) data across the participants. The class imbalance problem is always encountered in machine learning in practice, that causes bad prediction on minority classes. In this work, We propose FedBGVS to alleviate the class bias severity by employing a balanced global validation set. The model aggregation algorithm is refined y using the Balanced Global Validation Score (BGVS). We evaluate our methods by experiments conducted on both the classical benchmark datasets MNIST, SVHN and CIFAR-10 and a public clinical dataset ISIC-2019. The empirical results demonstrate that our proposed methods outperform the state-of-the-art federated learning algorithms in label distribution skew and class imbalance settings.

EASE 2021: International Conference on Evaluation and Assessment in Software Engineering (21-24 June 2021; Online)

Jiahui Geng, Neel Kanwal, Martin Gilje Jaatun, Chunming Rong, DID-eFed: Facilitating Federated Learning as a Service with Decentralized Identities. 25th International Conference on Evaluation and Assessment in Software Engineering

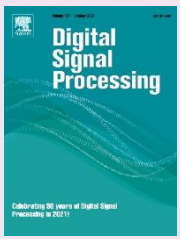
We have entered the era of big data, and it is considered to be the "fuel" for the flourishing of artificial intelligence applications. The enactment of the EU General Data Protection Regulation (GDPR) raises concerns about individuals' privacy in big data. Federated learning (FL) emerges as a functional solution that can help build high-performance models shared among multiple parties while still complying with user privacy and data confidentiality requirements. Although FL has been intensively studied and used in real applications, there is still limited research related to its prospects and applications as a FLaaS (Federated Learning as a Service) to interested 3rd parties. In this paper, we present a FLaaS system: DID-eFed, where FL is facilitated by decentralized identities (DID) and a smart contract. DID enables a more flexible and credible decentralized access management in our system, while the smart contract offers a frictionless and less error-prone process. We describe particularly the scenario where our DID-eFed enables the FLaaS among hospitals and research institutions.

MICCAI 2021: International Conference on Medical Image Computing and Computer Assisted Intervention (27 Sep – 1 Oct 2021; Online)

Yunan Wu, Arne Schmidt, Enrique Hernández Sánchez, Rafael Molina, and Aggelos K. Katsaggelos, Combining Attention-based Multiple Instance Learning and Gaussian Processes for CT Hemorrhage Detection. 24th International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI 2021).

Intracranial hemorrhage (ICH) is a life-threatening emergency with high rates of mortality and morbidity. Rapid and accurate detection of ICH is crucial for patients to get a timely treatment. In order to achieve the automatic diagnosis of ICH, most deep learning models rely on huge amounts of slice labels for training. Unfortunately, the manual annotation of CT slices by radiologists is time-consuming and costly. To diagnose ICH, in this work, we propose to use an attention-based multiple instance learning (Att-MIL) approach implemented through the combination of an attention-based convolutional neural network (Att-CNN) and a variational Gaussian process for multiple instance learning (VGPMIL). Only labels at scan-level are necessary for training. Our method (a) trains the model using scan labels and assigns each slice with an attention weight, which can be used to provide slice-level predictions, and (b) uses the VGPMIL model based on low-dimensional features extracted by the Att-CNN to obtain improved predictions both at slice and scan levels. To analyze the performance of the proposed approach, our model has been trained on 1150 scans from an RSNA dataset and evaluated on 490 scans from an external CQ500 dataset. Our method outperforms other methods using the same scan-level training and is able to achieve comparable or even better results than other methods relying on slice-level annotations.

JOURNAL PAPERS



DIGITAL SIGNAL PROCESSING: Artificial intelligence in computational pathology – challenges and future directions

Sandra Morales, Kjersti Engan, Valery Naranjo, Artificial intelligence in computational pathology – challenges and future directions, 2021, 103196, ISSN 1051-2004

The field of digital histopathology has seen incredible growth in recent years. Artificial Intelligence (AI) algorithms may be used for the identification of relevant regions, extraction of features from a histological image and overall classification of images into specific classes. The combination of digital histopathology imaging and AI therefore presents a significant opportunity for the support of the pathologists' tasks and opens up a whole new world of computational analysis. In this paper, we have analysed the present, the challenges and the future of the computational pathology discussing the different existing strategies to overcome its main limitations and ensure the computational pathology acceptance. The lack of labelled data, which is the possibly largest challenge for all medical AI applications, is even more pronounced in computational pathology because of the multi-gigapixel nature of the images and high data heterogeneity. We consider the future of the computational pathology is the combination of weak label strategies with active learning and crowdsourcing scenarios since it would remove some of the workload from clinical experts and manual annotation obtaining clinically satisfactory performance with minimal annotation effort. In addition, we believe areas such as explainable AI, data fusion and secure role-based data sharing will be receiving increasing research attention in computational pathology in the close future.

- **Events and training**

NETWORK TRAINING ACTIVITIES

13-14 Apr 2021

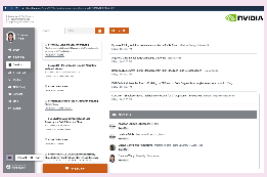
1st training School, the event was composed of 3 technical courses lectured by some of the CLARIFY supervisors and 3 master classes by some distinguished members of our External Advisory Board. Besides, we had also a workshop and two seminars to cover relevant transferable skills issues.

22 Jun 2021

ESRs had the pleasure to attend the **2nd CLARIFY Virtual Fieldtrip** titled "Anatomic pathology instruments and reagents" led by ROCHE, one of our partner organizations. ROCHE showed a virtual demo of some of their solutions for the Anatomic Pathology Lab.

LOCAL TRAINING ACTIVITIES

23-27 Mar 2020



ESR2 has attended **the 2020 international conference on high performance Computing & Simulation** (HPCS 2020) online event, Under the theme of "HPC and Modeling & Simulation for 21st Century", HPCS 2020 focused on a wide range of the state-of-the-art as well as emerging topics pertaining to high performance and large-scale computing systems at both the client and backend levels

1-5 Mar 2021

ESR11 attended the **Molecular diagnostics and genomics in breast cancer** event organized by **Onco Corner**, the e-learning platform from Sharing Progress in Cancer Care (SPCC).

22 Apr 2021

ESR4 at UiS attended a webinar on "**Enabling Interoperability for Digital and Computational Pathology in the Age of Artificial Intelligence: Current Status and Future Directions**" by the Digital Pathology Association (DPA).

26 May 2021

ESR12 attended the Online Course "**Spitzoid Melanocytic Tumors: Histological-Genetic Correlations: Expert Analysis of 70 Spitzoid Melanocytic Proliferations With Known Genetic Changes**"

24 Jun 2021

ESR3 and ESR4 presented their paper (**DID-eFed: Facilitating Federated Learning as a Service with Decentralized Identities**) at **EASE 2021** Trondheim Norway, within the **2nd Blockchain Software Engineering Workshop**.

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13-14 Sep 2021

ESR4 Neel Kanwal and ESR5 Saul Fuster Navarro presented their ongoing research about CLARIFY at **NOBIM** (Norwegian Association of Image Processing and Machine Learning) held at Oslo Gardermoen.

13-15 Sep 2021

ESR9 attended a **summer school** on AI, organized by Virtual Vehicle Research GmbH, Graz University of Technology and University of Graz.

15-22 Sep 2021

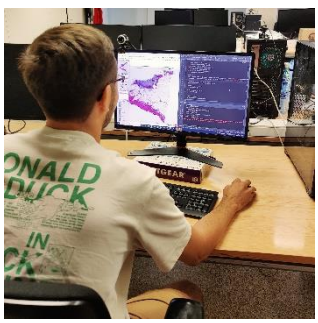
ESR10 and ESR11 attended **EMPAIA Academy** training program where renowned speakers from the fields of IT, artificial intelligence (AI) and pathology talked about their experiences, use cases and the latest developments in digital pathology. Courses: (i) Introduction to Pathology and AI in Pathology, (ii) Introduction to Computational Pathology, (iii) Requirements for Application of AI

27Sep - 1Oct 2021

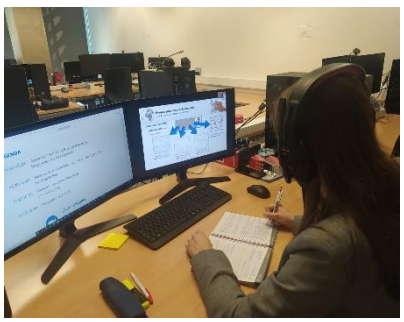
ESR8 presented a paper on the topic of Multiple Instance Learning in the 24th International Conference on **Medical Image Computing and Computer Assisted Intervention (MICCAI 2021).** This work is a successful collaboration between the University of Granada and the Northwestern University.

- **Secondments**

Host Entity:	*Host Supervisor:*	*Period of secondment:*	*ESR:*
Roche Diagnostics, S.L.U.	Carlos Manchado	mar 2021	ESR6, ESR7 and ESR12



During this virtual secondment, the ESRs participated in several synchronous workshops: (i) *New Tools for the Diagnosis of Breast Cancer*, (ii) *ALK (D5F3) and ROS1 (SP384) in Lung Cancer - Guides, tips and practical cases*, (iii) *Do we learn PD-L1* (SP263) in Lung Cancer? - Guides, tips and practical cases, as well as in other asynchronous workshops in the field of *"Pathology and Oncology"* and *"Digital solutions and diagnostic support"*



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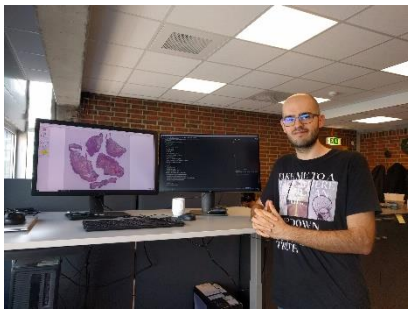
Host Entity:	*Host Supervisors:*	*Period of secondment:*	*ESR:*
Erasmus MC Rotterdam.	Tahlita Zuiverloon and Christiaan de Jong	mar-may 2021	ESR5



This virtual secondment consisted of crash courses related to the characterization of bladder cancer. Every week, ESR5 attended a course on molecular characterization of bladder cancer and on pathology in bladder cancer with an expert uropathologist from the hosting institution. Also, every week ESR5 attended a weekly lab meeting with the bladder cancer group, where once he presented his work until then in addition to introducing artificial intelligence and image processing. This meeting served as journal club where everyone in the Department of Urology did the same.

Host Entity:	*Host Supervisor:*	*Period of secondment:*	*ESR:*
Stavanger University Hospital.	Emiel Janssen and Vebjørn Kvikstad	apr-may 2021	ESR1, ESR4, ESR10

The secondment was held virtually to carry activities such as online lectures, interactive reading sessions, presentations, workshops, and suggested readings. The schedule included online lectures and suggested reading for every week. The topics covered in these sessions were related to digital pathology: (i) Quantitative pathology, possibilities and pitfalls, (ii) Practical insight into digital pathology and its requirements, (iii) WSI digitalization workflow and digital pathology diagnosis. The ESRs also investigated and discussed relevant literature in the field.

Host Entity:	*Host Supervisor:*	*Period of secondment:*	*ESR:*
University of Amsterdam	Zhiming Zhao	apr-jun 2021	ESR3

During this virtual secondment, ESR3 joined the weekly research meetings with the host institute. Host institute provided ESR3 with lectures on the Virtual research environment, scientific workflow management, and cloud computing. A joint experiment on the topic of blockchain, workflow, AI and cloud was defined.

Host Entity:	*Host Supervisor:*	*Period of secondment:*	*ESR:*
Instituto de Investigación Sanitaria INCLIVA	Carlos Monteagudo	may 2021	ESR7

The secondment consisted mainly in the acquisition of general knowledge in dermatopathology and spitzoid melanocytic tumors in particular. ESR7 had the opportunity to observe the scanning steps and other processes of the field, and attended the daily sign-out of cutaneous biopsies as well as the weekly meetings of the department.

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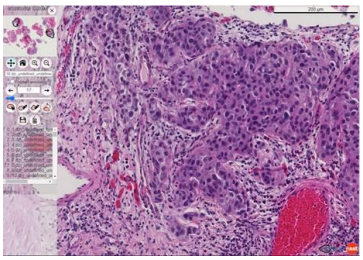
Host Entity:	*Host Supervisor:*	*Period of secondment:*	*ESR:*
University of Stavanger	Trygve Eftestol and Kjersti Engan	apr-jun 2021	ESR8

This virtual secondment was divided into three topics: WSI preprocessing and anonymization, Bladder Cancer Classification and Multiple Instance Learning with Attention Mechanism. A joint review paper resulting of the collaboration on Deliverable D3.1 "Preprocessing and Standardization Protocol" is in progress. A joint publication between ESR8 and ESR5 about the classification of bladder cancer with Attention Multiple Instance Learning methods is planned.

Host Entity:	*Host Supervisor:*	*Period of secondment:*	*ESR:*
Erasmus MC Rotterdam	Tahlita Zuiverloon	apr-jul 2021	ESR12



The virtual secondment in Erasmus Medisch Centrum (EMC) in Rotterdam consisted in attending to the weekly lab meeting with the bladder cancer group and a virtual course on pathology in bladder cancer provided by the EMC's uropathologist.

Host Entity:	*Host Supervisor:*	*Period of secondment:*	*ESR:*
Instituto de Investigación Sanitaria INCLIVA	Carlos Monteagudo	jul 2021	ESR9

The aim of the secondment was to provide the ESR9 with clinical knowledge for diagnosis of Spitzoid Melanocytic Lesions (SML). ESR9 acquired knowledge on tissue processing, routine staining techniques and immunohistochemical and molecular typification of cutaneous neoplasms, with particular emphasis on melanocytic tumors. ESR9 was taught about the scanning process of tissue slides and participated in the annotation of whole slide images of spitzoid melanocytic tumors.

Upcoming events

The **second CLARIFY Training School** and the second annual meeting, organized by the University of Granada (UGR), will be held in February, 2022. Technical lectures 2 on "Establishing the fundamentals and advanced methods in Artificial Intelligence for Medical Applications", Workshop II on "Project Management and Research Communication" and Seminar II on "Responsible Research and Innovation (RRI) II" will take place during those days.

Four secondments will take place from September to December 2021.