Cloud ARtificial Intelligence For pathologY

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SIXTH NEWSLETTER – dec 2023

Welcome to the sixth newsletter!

CLARIFY is now in the final stretch, and therefore there are many important events that have taken place in recent months.

In April, the **3rd training school** was held **in Amsterdam** which was full of interesting talks and technical lectures. But also, in June we had the opportunity to meet again in **Stavanger**, where **activities more focused on promoting teamwork** and on **possibilities after** completing their **PhD** were prepared.

Furthermore, most **ESRs are already finishing their research**, so these have been months of **intense activity** for them in terms of **publications** and presentations at **conferences**.

If you want to know all the details of the **final CLARIFY conference** that we are preparing, as well as being up to date with the latest progress of the project, read on, and don't forget to follow us on our **social networks** and visit our **website**.

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CLARIFY in a Nutshell

4 Universities
UPV, UGR, UvA & UiS

3 Hospitals
INCLIVA, SUH & EMC

2 Companies
BitYoga & Tyris Software

12 ERSs

Milestones achieved

| **Monthly meetings** between ESRs and supervisors	**2 secondments** concluded from March to November 2023	**3 Scientific deliverables**	**11 conference papers** since the last newsletter	**3 journal papers** since the last newsletter

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Scientific Deliverables

D2.4. Anonymization algorithms

Members of WP2 participated in the discussion and writing of D2.4, which describes **challenges in data privacy for developing computational pathology algorithms**. The deliverable gives details about key elements of privacy in histological data, nuances of technical and legal terms, and existing frameworks for anonymization, along with how they lack in providing operational methods for histological data that satisfy legal and technical advancements. In this deliverable, we ascertain the **need for a user-centric platform** that balances privacy and progress in **AI by combining emerging technologies** for improved patient privacy.
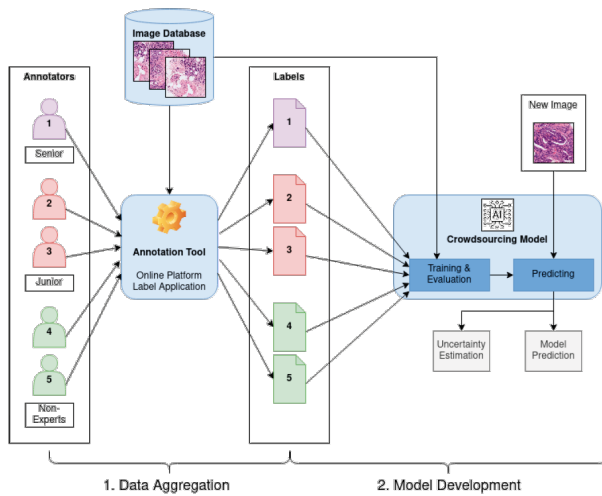

D3.3. Crowdsourcing models for automatic diagnosis

This Deliverable is part of WP3 about the "Automatic WSI interpretation through AI". After describing methods and advances in preprocessing (D3.1) and feature extraction (D3.2), D3.3 outlines **crowdsourcing models for automatic diagnosis**. Crowdsourcing models are AI models that are able to incorporate (subjective) labels of a crowd of individuals rather than a single ground truth. This is **highly relevant for the project** because the assessment of medical images depends on the level of experience, personal judgment, and special knowledge of the medical experts, leading to high variability in the assigned labels. In this Deliverable, an **overview of relevant crowdsourcing methods** to address this problem has been provided.

D3.4. CBIR algorithms

D3.4 describes the **challenges associated with Content-Based Image Retrieval** (CBIR) in the context of histopathological images. This deliverable explains the **demand for high-performance GPUs** and suggests that Federated Learning (FL) can offer a solution for this issue. This document delves into essential components, encompassing diverse datasets like BreaKHis (for breast cancer), SICAPv2 (for prostate cancer), CLARIFY dataset (for skin cancer), and Arvaniti (for prostate cancer).

Moreover, **it explores various feature extractors**, such as Convolutional Auto Encoders and Siamese networks, **to elevate the performance of the CBIR tool**. This deliverable also highlights the **impacts of color variation** on the final performance of a CBIR tool and it has some suggestions on how to address it.

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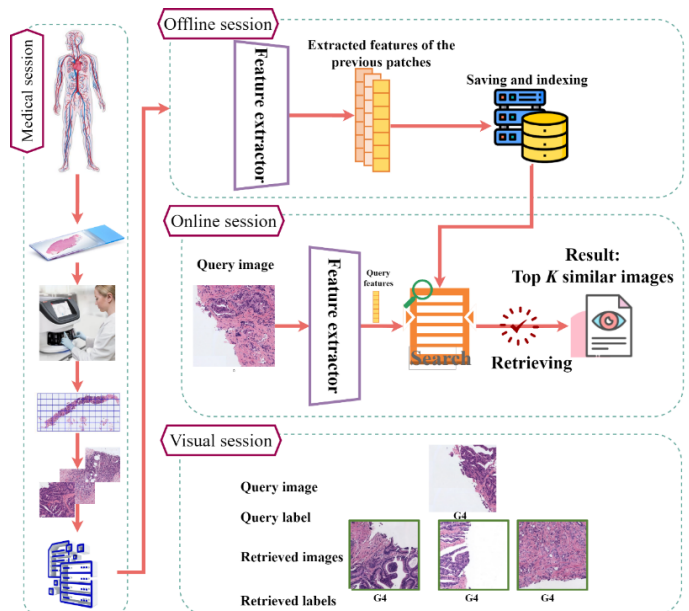
ESR project updates

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

- Presented and published a conference paper titled: "**CNSVRE: A Query Reformulated Search System with Explainable Summarization for Virtual Research Environment**" in the International World Wide Web Conference 2023.
- Presented and published a conference paper titled: "**A Dense Retrieval System and Evaluation Dataset for Scientific Computational Notebooks**" in 2023 IEEE Conference.

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

- Presented and published a conference paper titled: "**Towards a Service-based Adaptable Data Layer for Cloud Workflows**" at the COMPSAC 2023 Conference.
- Presented two **poster** abstracs in the **eScience 2023** Conference titled "**CWL-FLOps: A Novel Method for Federated Learning Operations at Scale**" and "**Towards a Knowledge Graph enhanced automation and collaboration framework for Digital Twins**".
- Presented a **work-in-progress paper** in the IEEE ICDH 2023 Conference.
- Attended the Advanced School for Computing and Imaging Course.

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

- **Presentation** about our accepted paper "A Survey on Dataset Distillation: Approaches, **Applications and Future Directions**" in the IJCAI2023.
- Preparation of **CLARIFY** deliverable **D4.2.** Image retrieval tool **t**ogether with ESR 9.
- Last months focused on the writing of the **doctoral thesis** and preparation of the **defense**, which took place on 27 September 2023.

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

- Presentation on "**Vision Transformers for Small Histological Datasets Learned Through Knowledge Distillation**" at the PAKDD2023 Conference.
- Presented a conference paper titled "**Detection and localization of melanoma skin cancer in histopathological whole slide images**" at the EUSIPCO 2023 Conference.
- **Attended the NORA Summer School** which focused on the latest topics and discussions on self-supervised learning for medical data, **and** also attended the **ACM Summer School**, most focused on the use of supercomputing for dedicated AI applications.
- Presentation on "**Balancing Privacy and Progress in Artificial Intelligence: Anonymization in Histopathology for Biomedical Research and Education**" at the FAIEMA 2023 Conference.
- Attended a scientific writing workshop organized by Digital Life Norway.
- Co-authored a paper with ESR2 and submitted it to IEEE IPDPS.

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

- Poster presentation of a **conference paper** about melanoma prognosis **at the ISBI2023.**
- Presentation of a **conference paper** titled **"Active Learning Based Domain Adaptation for Tissue Segmentation of Histopathological Images"** at the EUSIPCO 2023 Conference.
- Working on the writing of the thesis, which he plans to defend in March/April 2024.

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

- **Secondment at ROCHE Diagnostics** S.L in Barcelona, Spain together with ESR7 and ESR12 in March.
- **Submitted a paper** entitled: "Uninformed Teacher-Student for hard-samples distillation in weakly supervised mitosis localization" in CMIG: Computerized Medical Imaging and Graphics journal
- Started his **research on Survival Prediction and Risk Stratification of Breast Cancer patients.**

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

- **Collaboration with ESR12** on an **approach leveraging histological features** analyzed by pathologists to aid in the classification of spitzoid tumors in the clinical practice.
- Integration of active learning in a real-world scenario.
- Obtained the **first prize in the 3-minute thesis award at the EUSIPCO conference** held in Helsinki, Finland in September: "Deep Learning Methodologies for Spitzoid Melanocytic Tumors Characterization".
- Started a new contract in the same lab, CVBLab, at UPV.

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

- Poster presentation on "**Probabilistic Modeling of Inter- and Intra-observer Variability in Medical Image Segmentation**" at ICCV 2023.
- Journal paper published in Pattern Recognition journal: "**Introducing instance correlation in multiple instance learning. Application to cancer detection on histopathological images**".
- After finishing his contract as ESR8 at CLARIFY, he has started a new job as a Data Scientist at Aignostics GmbH, working in the field of digital pathology.

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

- **Published** a **paper** entitled: "**WWFedCBMIR: World-Wide Federated Content-Based Medical Image Retrieval**" in MDPI, bioengineering.

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- Presented a conference paper **"Self-supervised learning of a tailored Convolutional Auto Encoder for histopathological prostate grading"** at the EUSIPCO 2023 Conference.

- **Submitted conference paper** titled "*Advancing CBHIR Pre-processing: Comparative Analysis of the Effects of Color Normalization Techniques on Content-Based Histopathological Image Retrieval*" to ECIR 2024

- **Submitted** a paper entitled: **"Towards More Transparent and Accurate Cancer Diagnosis with an Unsupervised CAE Approach** in IEEE Access. It received minor revision.

- Prepared the front end with the connection of APIs of segmentation, classification, and CBHIR

- Prepared deliverable **D3.4**.

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

- Developing **supervised** and **weakly supervised methods to predict molecular subtypes from bladder cancer histology slides**.

- **Publishing a systematic review** entitled "**Artificial Intelligence in Digital Pathology for Bladder Cancer: Hype or Hope? A Systematic Review**".

- Isolating RNA and scanning slides to create an independent cohort to validate the molecular subtype prediction model.

- Submitting two abstracts for **EAU24.**

- Accepted for a presentation at **IBCN23**.

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

- Focused on more advanced molecular techniques to get detailed information about tumor infiltration lymphocytes (TILs) and the study of gene expression analysis of tripe negative breast cancer (TNBC) to better understand the nature of TILs.

- Working on **new biomarkers** that will show **prognostic** effects in **TNBC**.

- Working on **testing** the **previously described automated TILs quantification algorithms** to her dataset.

- Attended **19th European Congress on Digital Pathology** in Budapest to improve her knowledge about breast cancer and digital pathology.

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"*

- Published a public database: "**Spitzoid Tumor dataset with clinical metadata and Whole Slide Images for Deep Learning models**".

- **Submitted a journal paper** titled "Beyond nest size: the clinicopathologic spectrum of large nested melanocytic tumors and the diagnostic value of immunohistochemistry, genetics, and epigenetics" to Histopathology journal.

- **Presented a lecture** on computational pathology in the V Colombian Conference of Cytophatology, held in Bogotá.

- **Secondment at SUH and Roche Diagnostics**.

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What's happening?

- 11 conference papers
- 4 journal papers
- 2 Secondments
- 8 local training activities
- 3 network training activities

- **Scientific publications**

CONFERENCE PAPERS

E-Science: 2023 IEEE 19th International Conference on e-Science (Oct, 2023)

Na Li, Yangjun Zhang and Zhiming Zhao:

A Dense Retrieval System and Evaluation Dataset for Scientific Computational Notebooks

E-Science: 2023 IEEE 19th International Conference on e-Science (Oct, 2023)

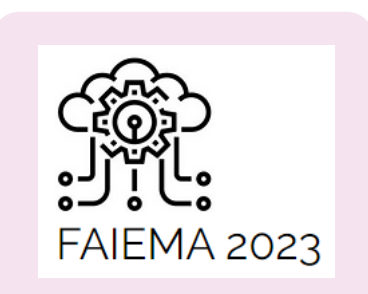Chronis Kontomaris; Yuandou Wang; Zhiming Zhao:

CWL-FLOps: A Novel Method for Federated Learning Operations at Scale

E-Science: 2023 IEEE 19th International Conference on e-Science (Oct, 2023)

Vasileios Christou; Yuandou Wang; Zhiming Zhao:

Towards a Knowledge Graph Enhanced Automation and Collaboration Framework for Digital Twins

FAIEMA 2023: 1st International Conference on Frontiers of Artificial Intelligence, Ethics, and Multidisciplinary Applications (Sep, 2023)

Neel Kanwal, Emiel A.M. Janssen, Kjersti Engan:

Balancing Privacy and Progress in Artificial Intelligence: Anonymization in Histopathology for Biomedical Research and Education

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EUSIPCO 2023: 31st European Signal Processing Conference (Sep, 2023)

Zahra Tabatabaei, Adrián Colomer, Kjersti Engan, Javier Oliver and Valery Naranjo

Self-supervised learning of a tailored Convolutional Auto Encoder for histopathological prostate grading

EUSIPCO 2023: 31st European Signal Processing Conference (Sep, 2023)

Neel Kanwal, Roger Amundsen, Helga Hardardottir, Luca Tomasetti, Erling Sandoy Undersrud, Emiel A.M. Janssen, Kjersti Engan

Detection and Localization of Melanoma Skin Cancer in Histopathological Whole Slide Images

IEEE ICDH 2023: IEEE Conference on Digital Health (Sep, 2023)

Yuandou Wang, Neel Kanwal, Kjersti Engan, Chunming Rong, Zhiming Zhao:

Towards a privacy-preserving distributed cloud service for preprocessing very large medical images

IJCAI 2023: 32nd International joint Conference on Artificial Intelligence (Aug, 2023)

Jiahui Geng, Zongxiong Chen, Yuandou Wang, Herbert Woisetschlaeger, Sonja Schimmler, Ruben Mayer, Zhiming Zhao, Chunming Rong:

A Survey on Dataset Distillation: Approaches, Applications and Future Directions

COMPSAC 2023 Theme: Resilient Computing and Computing for Resilience in a Sustainable Cyber-Physical World (Jun, 2023)

Yuandou Wang; Nikita Janse; Riccardo Bianchi; Spiros Koulouzis; Zhiming Zhao:

Towards a Service-based Adaptable Data Layer for Cloud Workflows

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PAKDD 2023: The 27th Pacific-Asia Conference on Knowledge Discovery and Data Mining (May, 2023)

Neel Kanwal, Trygve Eftestol, Farbod Khoraminia, Tahlita CM Zuiverloon, Kjersti Engan:

Vision Transformers for Small Histological Datasets Learned Through Knowledge Distillation

WWW 2023 : 2023 ACM Web Conference (Apr, 2023)

Na Li, Yangjun Zhang and Zhiming Zhao

CNSVRE: A Query Reformulated Search System with Explainable Summarization for Virtual Research Environment

JOURNAL PAPERS

Scientific data: A Spitzoid Tumor dataset with clinical metadata and Whole Slide Images for Deep Learning models (Oct, 2023)

Andrés Mosquera-Zamudio, Laëtitia Launet, Rocío del Amor, Anaïs Moscardó, Adrián Colomer, Valery Naranjo and Carlos Monteagudo

https://doi.org/10.1038/s41597-023-02585-2

Patter Recognition – Bioengineering: Introducing instance label correlation in multiple instance learning. Application to cancer detection on histopathological images (Oct, 2023)

Pablo Morales-Álvarez, Arne Schmidt, José Miguel Hernández-Lobato and Rafael Molina

https://doi.org/10.1016/j.patcog.2023.110057

MDPI – Bioengineering: WWFedCBMIR: World-Wide Federated Content-Based Medical Image Retrieval (Sep, 2023)

Zahra Tabatabaei, Yuandou Wang, Adrián Colomer, Javier Oliver Moll, Zhiming Zhao and Valery Naranjo

https://doi.org/10.3390/bioengineering10101144

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MDPI – Cancers: Artificial Intelligence in Digital Pathology for Bladder Cancer: Hype or Hope? A Systematic Review (Sep, 2023)
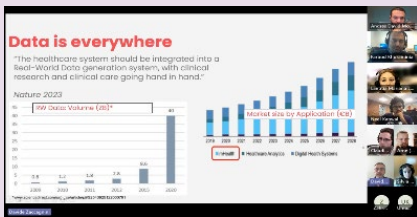
Farbod Khoraminia, Saul Fuster, Neel Kanwal, Mitchell Olislagers, Kjersti Engan, Geert J. L. H. van Leenders, Andrew P. Stubbs, Farhan Akram and Tahlita C. M. Zuiverloon

https://doi.org/10.3390/cancers15184518

• **Events and training**

NETWORK TRAINING ACTIVITIES

27 Jun 2023

ESRs had the pleasure to attend the **5th CLARIFY Virtual Fieldtrip** titled *"Validating and implementing decision support technologies in real-world healthcare settings"* led by Lynkeus, one of our partner organizations. Davide Zaccagnini, from Lynkeus, and Founder and CEO of Agora Labs, took us into the world of decision support technologies in the field of health, and explained how these innovations are impacting and transforming decision real-time decision-making.

5-7 Jun 2023

CLARIFY meeting in Stavanger

The meeting took place at the University of Stavanger, and consisted of a series of activities and talks to promote teamwork, as well as provide ESRs with the different possibilities they have to guide their careers once they finish their projects at CLARIFY.

24-26 Apr 2023

3rd CLARIFY Training school

The meeting was organized by the University of Amsterdam and was focused on Data Management. The event was made up of 2 technical lectures given by 2 CLARIFY supervisors, 2 master classes given by 2 EAB members and 3 workshops to cover relevant transferable skills issues.

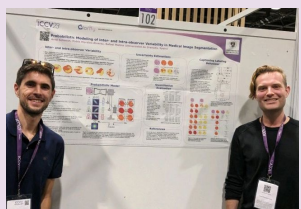**www.clarify-project.eu**

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25-27 Oct 2023

V Congreso Colombiano de Citopatología: ESR12 presented a lecture

ESR12 presented a lecture about his experience in the field of computational pathology in the V Colombian Conference of Cytophatology, organized by the Colombian Assotiation of Cytopathology held in Bogotá, Colombia.

2-6 Oct 2023

ICCV 2023: ESR8 presented a poster at the ICCV2023 Conference

ESR8 presented a poster about the accepted paper "*Probabilistic Modeling of Inter- and Intra-observer Variability in Medical Image Segmentation*" at the International Conference on Computer Vision 2023, held in Paris.

4-8 Sep 2023

EUSIPCO 2023: ESR 7 obtained the 1st prize in the 3MT award at the EUSIPCO 2023 Conference

ESR7 obtained the first prize in the 3 Minute Thesis (3MT) award at the EUSIPCO Conference held in Helsinki, Finland in September "*Deep Learning Methodologies for Spitzoid Melanocytic Tumors Characterization*".

3-7 Jul 2023

ACM Europe Summer School: ESR4 participated ACM Europe Summer School 2023.

They were part of the conference titled "HPC Computer Architectures for AI and Dedicated Applications," organized by the Barcelona Supercomputing Center.

14-17 Jun 2023

ECDP 2023: ESR11 attended the 19th European Congress on Digital Pathology.

This event discussed the novel aspects of integrative pathology, the strengths of implementing a digital workflow, as well as the benefits and future applications of an AI-assisted work environment and was held in Budapest.

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12-16 Jun 2023

NORA Summer School 2023: ESR4 participated in NORA Summer School 2023.

The school covered the latest topics and discussions on self-supervised learning for medical data.

18-21 Apr 2023

IEEE-ISBI 2023: ESR5 attended and presented a poster at the International Symposium on Biomedical Imaging

ESR5 gived a poster presentation about a conference paper "**Deep Learning for Predicting Metastasis on Melanoma WSIs**" at the 20th IEEE International Symposium on Biomedical Imaging, which was held in Cartagena de las Indias, Colombia.

13-16 Mar 2023
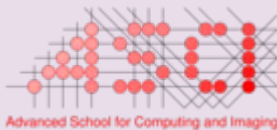
ASCI A28 Distributed Systems Course: ESR2 attended the Advanced School for Computing and Imaging Course 2023.

Oriented towards learning about the basic principles of modern distributed systems, and the differentiation between many kinds of modern distributed applications. Also focused on acquiring basic practical experience with modern distributed systems.

- **Secondments**

Since the CLARIFY project is ending and the ESRs are already very focused on finishing their project research, during these last few months only **3 of our 12 ESRs** have been in a secondment. In total, **2 secondments** have been carried out.

Host Entity: Roche Diagnostics S.L.	*Host Supervisor:* Ferrán Brianso	*Period of secondment*: March 2023	*ESR:* **ESR6, ESR7 and ESR12**

In March 2023, ESR6, ESR7 and ESR12 participated in a hybrid secondment at Roche Diagnostics. Two weeks were held online with a set of workshops and conferences, and the ESRs spent an additional two weeks on-site at Roche Diagnostics' offices in Sant Cugat del Vallès, Barcelona. Highlights of the on-site visit included exploring the digital pathology laboratory, gaining firsthand experience with cutting-edge technology in the field, and touring Roche's distribution warehouse

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Host Entity:	Host Supervisor:	Period of secondment:	ESR:
Helse Stavanger HF	Emiel Janssen	June-July 2023	ESR12

During his time there, ESR12 was privileged to be surrounded by an environment that seamlessly integrated natural beauty with cutting-edge research. The crisp Norwegian air and serene surroundings were juxtaposed with bustling university corridors and lively discussions. The duality of Stavanger's character, where tranquility meets innovation, played a pivotal role in shaping my academic journey.

But it was the people, more than the place, that left an indelible mark. Mentors like Emiel Janssen and Sigmund Sperstad, with their vast knowledge and guidance, and colleagues from the Molecular and Digital Pathology team added depth to the ESR12 Stavanger experience.

The collective spirit of collaboration and mutual growth was palpable, making his tenure there both productive and memorable.

As ESR12 reflect on this chapter, Stavanger emerges not just as a city but as a confluence of experiences that have enriched his professional journey.
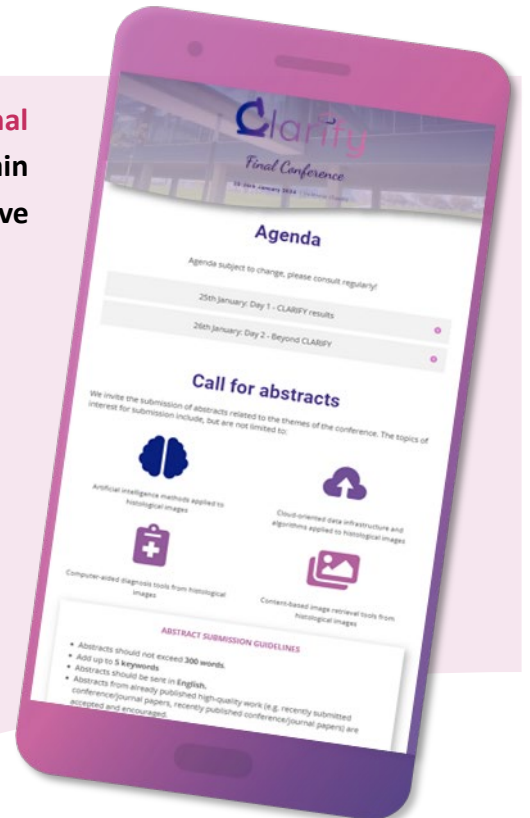
Upcoming events

CLARIFY Final Conference!

CLARIFY is about to finish and we are organizing the **Final Conference**: **A two-day event in which the main achievements of CLARIFY will be highlighted and have high-profile researchers in the field as invited speakers!**

The aim of the symposium is to provide an **event for the research and clinical community** that facilitates discussion and lays the foundations for future developments and collaborations. The symposium is **open to the research community**, registration for the event is free of charge and attendees are invited to contribute with poster presentations

Check out the website we created to find out more about this event!

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