EMBL

EMBL Barcelona

Highlights Report 2025

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Welcome to EMBL Barcelona

A translational year for EMBL Barcelona

2025 has been a year of harvesting the rewards of seeds sown nearly a decade ago. EMBL Barcelona has grown into a vibrant community of young, interdisciplinary researchers from across the globe, united by a shared passion for understanding tissue development in both health and disease.

Our institute is thriving in a fertile research landscape that perfectly spans the spectrum from fundamental science to biomedical applications. This year, our research groups have taken bold steps to advance EMBL Barcelona's position in innovative translational research: among our seven groups, one has filed four patents, with one already secured under an industrial agreement for manufacturing. *Model-MI*, a project aimed at improving women's health during pregnancy, has received funding of up to €3 million to develop a spin-off company over the next three years. We also launched our first public-private partnership with a consortium of research institutes and a therapeutics company to tackle small-cell lung cancer, among many other pioneering initiatives.

2025 also marked a milestone: for the first time, a research group transitioned to another institute. We are immensely proud that our first Group Leader, Miki Ebisuya, was awarded a Humboldt Professorship and has established her group at the Cluster of Excellence *Physics of Life* at TU Dresden.

I would like to congratulate all of EMBL Barcelona on a year full of firsts and achievements, and I look forward to an exciting 2026 filled with new adventures and breakthroughs.

James Sharpe,
Head of EMBL Barcelona

"I am incredibly proud of this year's achievements and of the vital role our administration and operations team has played in enabling research at EMBL Barcelona. For an institute like ours, having a dynamic, professional team of experts that is capable of structuring, coordinating, and enabling our unit-wide projects is essential. Their dedication not only makes today's successes possible but also lays the foundation for even greater discoveries in the years to come."

Laura Marin,
Head of Administration
EMBL Barcelona

Science in action

EMBL Barcelona is a dynamic community of international scientists pioneering new ways to understand how human tissues and organs function. The unit is currently home to seven research groups, which together cover a wide array of cutting-edge topics in tissue biology and disease modelling, using interdisciplinary approaches that combine organoid and gastruloid development, tissue engineering, vascular models, and mathematical approaches. Located in the Barcelona Biomedical Research Park (PRBB) on Barcelona's seafront, we thrive within a vibrant scientific hub, working closely with the Centre for Genomic Regulation (CRG), the Institute for Bioengineering of Catalonia (IBEC), Pompeu Fabra University (UPF), and the Spanish National Research Council (CSIC) to push the frontiers of developmental, tissue and vascular biology. Our laboratories and facilities host:

- six research groups working on understanding tissues, both in health and in disease,
- a Mesoscopic Imaging Facility with cutting-edge equipment and comprehensive services for users,
- a micro-fabrication laboratory that serves as a makerspace for researchers in the life sciences, a joint initiative within the PRBB
- a highly skilled operations and administration team that contributes to the smooth functioning of our Unit.
- the Barcelona Collaboratorium for Modelling and Predictive Biology, a joint initiative with the CRG
- a strong collaboration with the UPF-CRG Flow Cytometry Core Facility

Here, we highlight some of EMBL Barcelona's 2025 scientific achievements and activities.

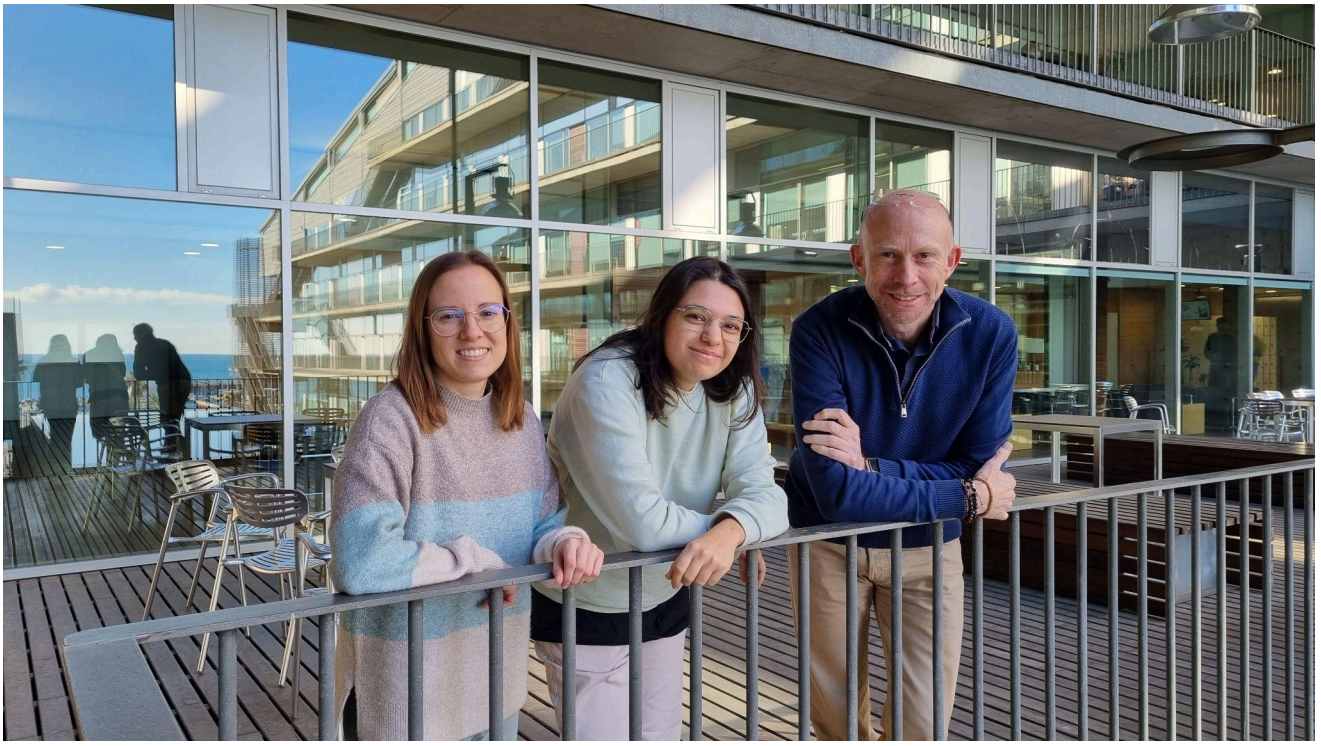
Our research groups investigate tissue biology and disease modelling using diverse scientific approaches. The Haase, Dayton, and Bernabeu groups employ *in vitro* systems, including organoids and organs-on-chip, to study disease progression in vascular dysfunction, cancer, and cerebral malaria. The Trivedi group focuses on the mechanisms of self-organisation and cell-fate determination in gastruloid models. The Sharpe and Torres-Sánchez groups use computational simulations and mathematical modelling to explore organogenesis, as well as the physical properties and dynamics of multicellular systems.

Publications

How video games inspired a new way to visualise limb development

The Sharpe Group published the paper '*Spatio-temporal reconstruction of gene expression patterns in developing mice'* in the journal *Development*. Researchers have found a way to visualise the continuous evolution of gene expression patterns in development, which is a big challenge for developmental biologists, by applying a technique often used by video game developers.

"The breakthrough came from an unexpected source – video games! One evening, while playing, I realised that game developers use 'something' to create smooth yet flexible interpolations for camera movements and animations. I found that this 'something' is a set of mathematical functions known as B-splines. This technique provided exactly what we needed: an interpolation method that was both arbitrary and smooth. By adopting B-splines, we were able to create a method that seamlessly integrates different sources of imaging data to generate a smooth reconstruction of gene expression patterns in time and space," explained Laura Aviñó-Esteban, PhD student at the Sharpe Group and first author of the publication.



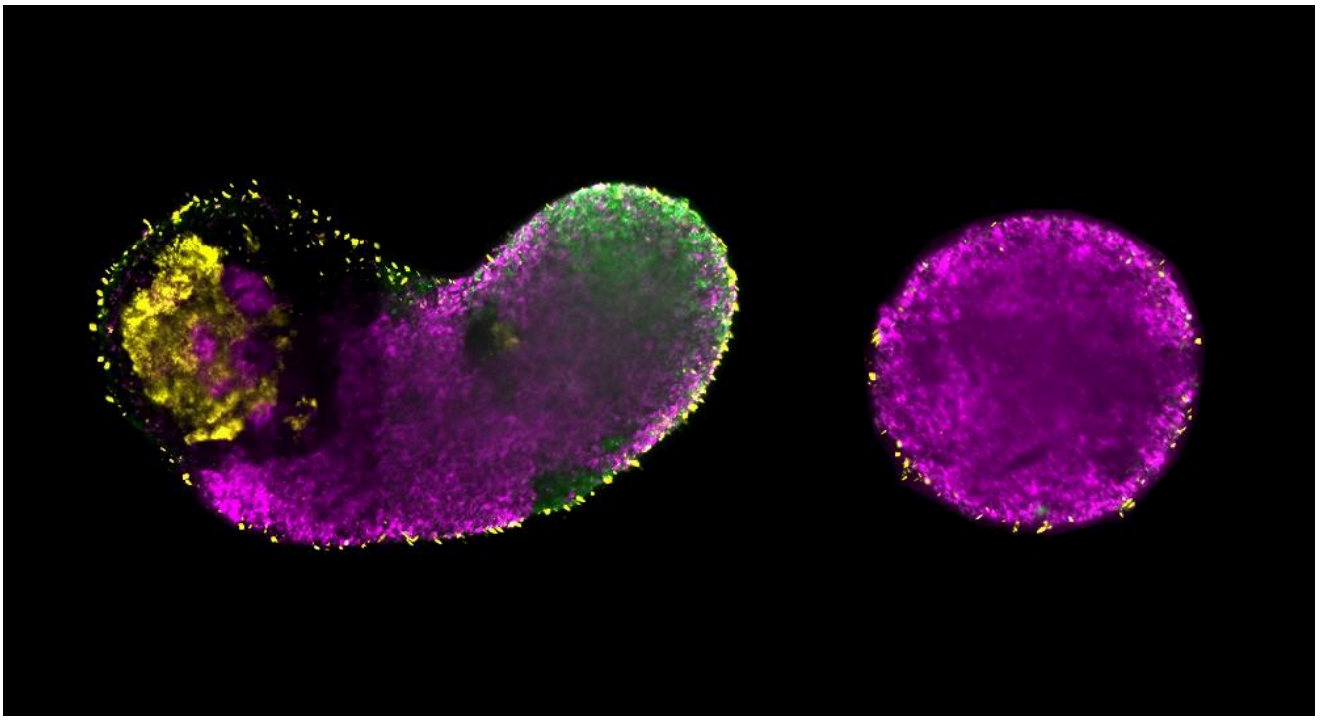
Caption: From left to right: Heura Cardona, Laura Aviño-Esteban and James Sharpe, authors of the work published in the journal *Development*. **Credit:** Carla Manzanas/EMBL

Metabolism shapes life

EMBL Barcelona and MPI-CBG Dresden researchers revealed how glycolysis drives early embryonic cell decisions. Glycolysis is an ancient metabolic activity. It consists of a set of reactions that convert glucose into energy. This central process allows cells to grow, divide, and stay alive. It has accompanied life since its origin, from single cells to complex organisms like mammals. Scientists have extensively studied the role of metabolism in individual cells to understand how it influences their energetic state, but little has been studied about the effect of glycolysis on the decisions that cells or groups of cells make.

“What was most surprising to me was this clear dual role of glycolysis: its bioenergetic function important for growth and its signalling function crucial for cell fate decisions. When we inhibited glycolysis, we clearly saw the loss of the endoderm and mesoderm, but we were able to rescue these cell types by activating the signalling pathways, even in the absence of glycolysis, meaning without restoring growth. This shows that we can decouple glycolysis’s bioenergetic role from its role as an upstream signalling regulator, underlining the existence of two distinct functions during early development,” said Kristina Stapornwongkul, Postdoctoral Fellow at Trivedi Group, now Group Leader at the Institute of Molecular Biotechnology (IMBA) in Vienna.

The work ‘*Glycolytic activity instructs germ layer proportions through regulation of Nodal and Wnt signaling*’ was published in the journal *Stem Cell Stem*.



Caption: On the left: glycolysis allows stem cell-based embryo-like models to develop the three germ layers that give rise to many different cell types: ectoderm (magenta), mesoderm (green), and endoderm (yellow). On the right: if glycolysis is inhibited, only ectodermal cells can develop. **Credit:** Kristina Stapornwongkul/EMBL

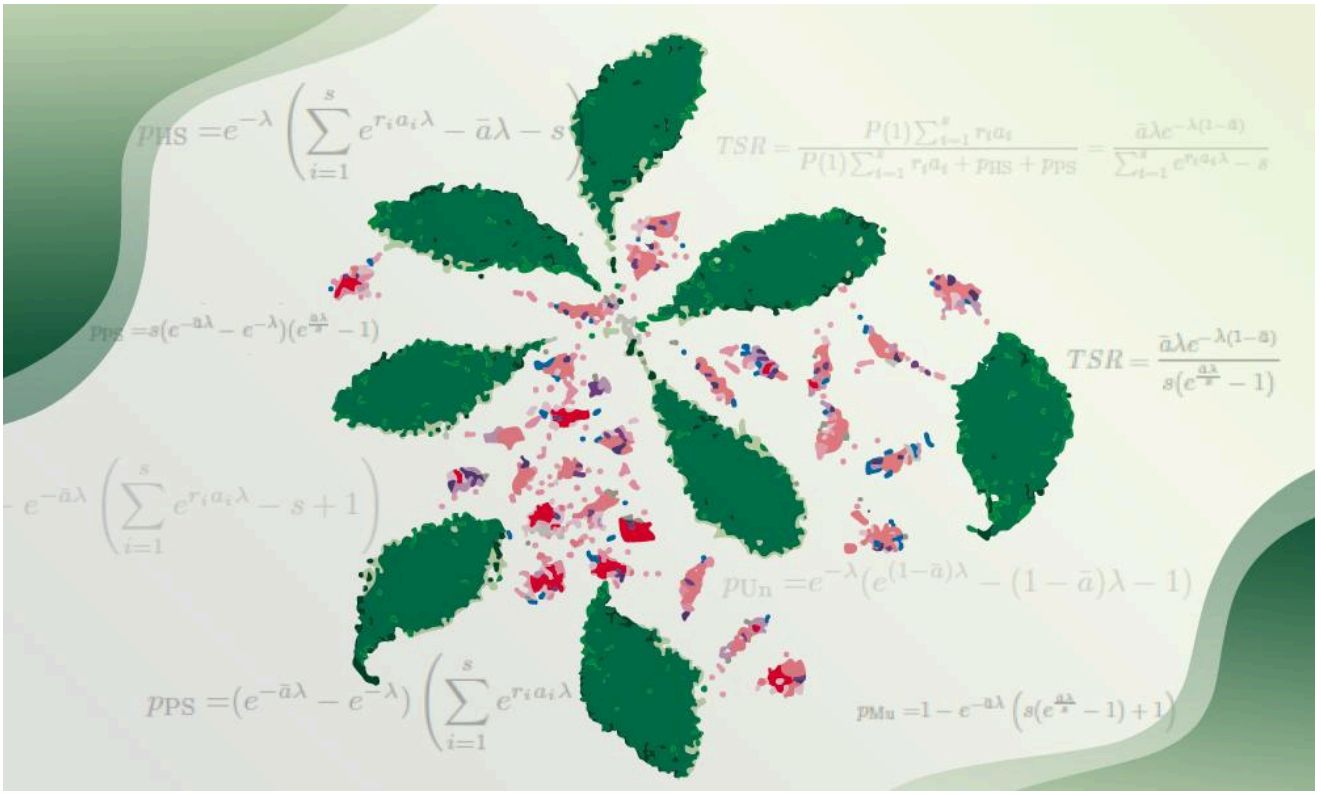
Spotting stealth multiplets for better single-cell experiment design

In a recent study, researchers from EMBL Barcelona provided new insights into some of the technical limitations of single-cell RNA sequencing (scRNA-seq), which could help scientists design better experiments.

Fumio Nakaki, Postdoctoral Fellow at EMBL Barcelona's Sharpe Group and first author of the work, quantitatively evaluated the risk of having undetected (or 'stealth') multiplets during sample multiplexing, both in theory and in practice.

"Our goal is to provide researchers with a practical reference point. Sample multiplexing is widely used, but its limitations are often overlooked. By clarifying how and when multiplets arise under multiplexed conditions, we hope this work will support better study design in experiments and data interpretation," said Nakaki.

The study '*Probability of stealth multiplets in sample-multiplexing for droplet-based single-cell analysis*' was published in the journal *BMC Genomics*.



Caption: Fumio Nakaki combined theoretical modelling with experimental benchmarking and used publicly available single-cell datasets to assess how sample multiplexing influences multiplet detection.
Credit: Fumio Nakaki/EMBL

Cerebral malaria: new study shows how the malaria parasite opens the way to the brain

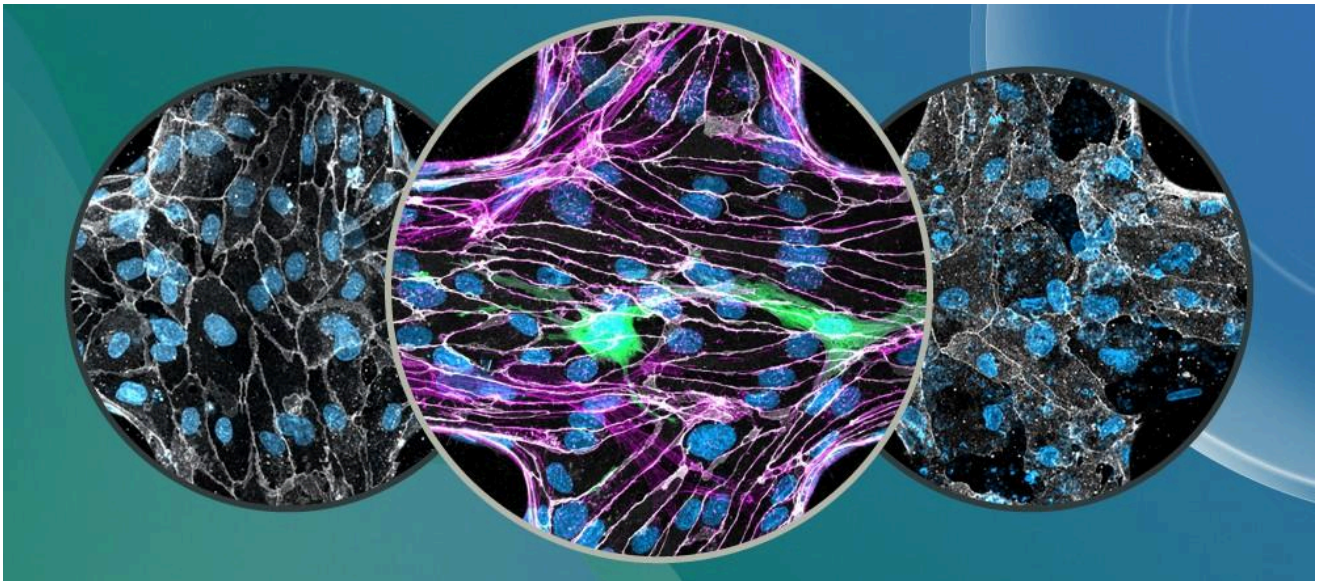
Researchers at Bernabeu Group have created a lab-grown blood-brain barrier to show how the parasite damages it, and have successfully tested potential therapeutics that could help prevent or even reverse the damage.

“You have to imagine the blood-brain barrier as a system of tightly sealed pipes that prevent leaks. The malaria parasite is capable of developing cracks in those pipes, and creating a leak that starts dripping infected fluid into the brain, causing swelling and making the disease irreversible,” said Livia Piatti, Postdoctoral Fellow at EMBL Barcelona’s Bernabeu Group and co-first author of the study.

The group built the most complete lab-grown infection model of the human blood-brain barrier to date. It includes the key cellular players: endothelial cells that line the blood vessels, supporting pericytes, and astrocytes, which are star-shaped brain cells, all arranged in a 3D structure with flowing fluid.

“To assess barrier disruption, we used a live-imaging approach that tracked fluorescent molecules leaking from the inside of the vessels to the surrounding area. When we applied parasite egress products or infected red blood cells, we observed a significant increase in tracer passage, indicating that the barrier had become more permeable,” said Alina Batzilla, Predoctoral Fellow in the Bernabeu Group and co-first author of the study.

The work titled ‘*Plasmodium falciparum egress disrupts endothelial junctions and activates JAK-STAT signaling in a microvascular 3D blood-brain barrier model*’ was published in the journal *Nature Communications*.



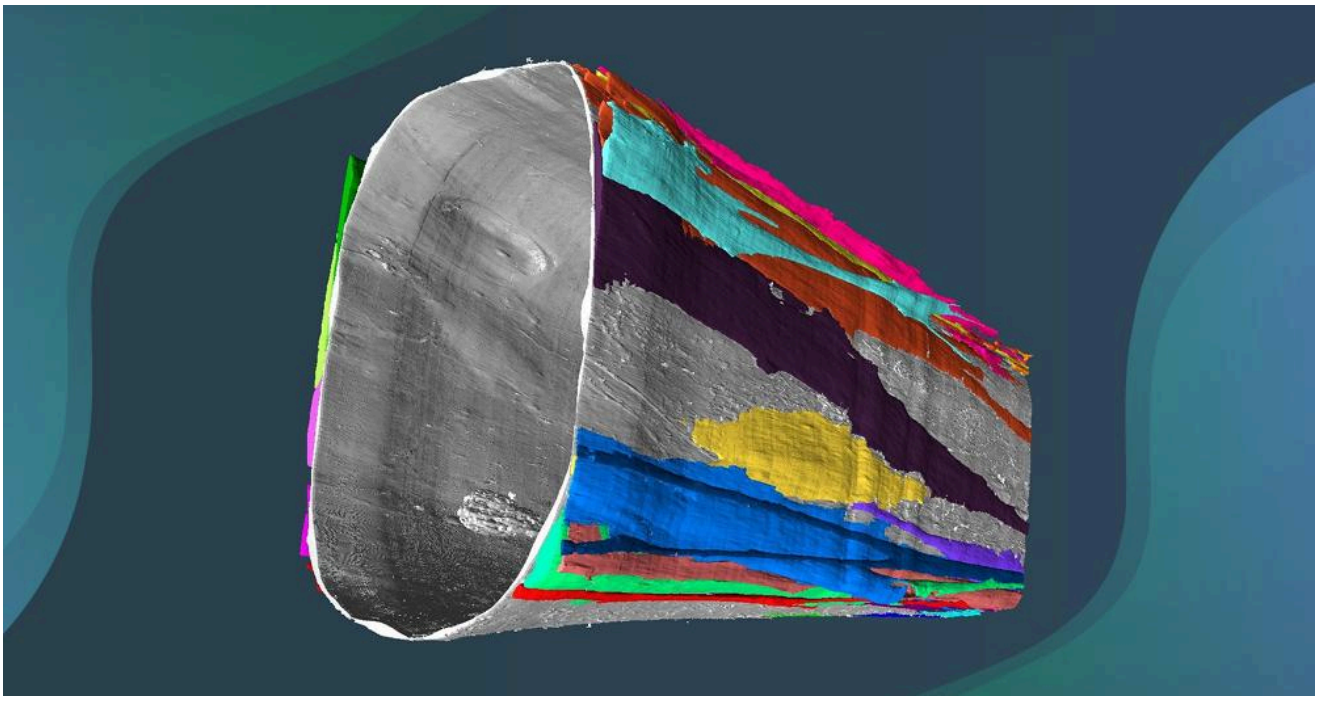
Caption: EMBL Barcelona researchers have created a lab-grown blood-brain barrier to show how the malaria parasite damages it, and have successfully tested potential therapeutics that could help prevent or even reverse the damage. **Credit:** Bernabeu Group/EMBL

The hidden life of pericytes: understanding how cerebral malaria breaks the blood-brain barrier

In the study '*Plasmodium falciparum impairs Ang-1 secretion by pericytes in a 3D brain microvessel model*' published in *EMBO Molecular Medicine*, researchers at Bernabeu Group highlighted malaria-induced disruption of pericytes – cells present along the walls of capillaries – bringing us a step closer to understanding how cerebral malaria damages the brain, and how these damages could be prevented or reversed.

Cerebral malaria infection causes severe damage to the brain's delicate blood vessels. A central player in this damage is the angiopoietin-Tie signalling pathway, which normally helps blood vessels stay stable, tight, and protected. The normal functioning of this pathway depends on the secretion of a molecule called angiopoietin-1 (Ang-1) by pericytes. Patients with cerebral malaria often show an imbalance in this pathway: too much of the destabilising molecule angiopoietin-2 and too little of the protective Ang-1.

"In this study, we generated an advanced 3D human brain microvasculature model that reproduces important *in vivo* interactions between human brain endothelial cells and pericytes," said Rory Long, Postdoctoral Fellow in the Bernabeu Group at EMBL Barcelona and first author of the work. "We show that disruption of the crucial role of pericytes in protecting and restoring the blood vessels promotes blood-brain barrier damage during cerebral malaria."



Caption: Image of a microvessel taken with serial-block face scanning electron microscopy at the Electron Microscopy Core Facility in EMBL Heidelberg. The endothelial microvessel is grey with many pericytes sitting on the endothelial surface (different colours represent individual pericytes). **Credit:** Rory Long/EMBL

From static papers to living models: turning limb development research into interactive science

LimbNET is an online platform that integrates computer modelling, experimental data, and 2D live simulations. The work, titled '*LimbNET: collaborative platform for simulating spatial patterns of gene networks in limb development*' was published in the journal *Molecular Systems Biology.*

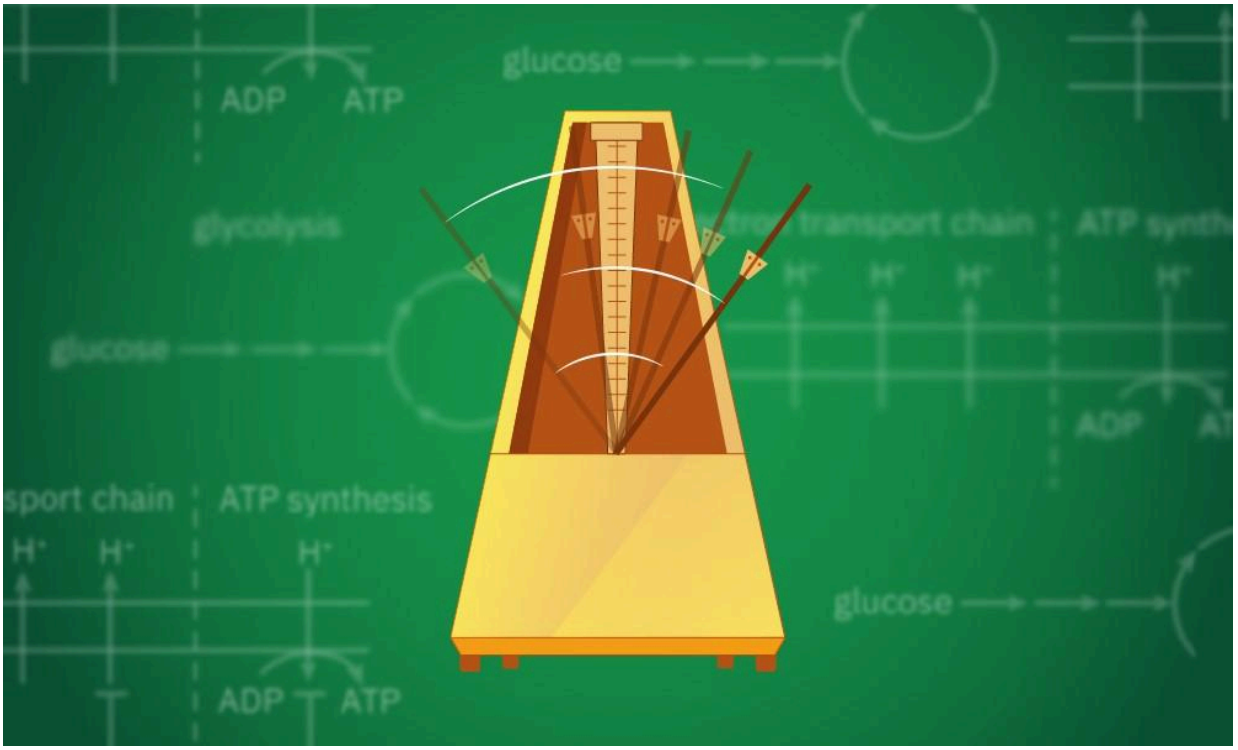
LimbNET is much more than a simple data repository. It is a new type of platform allowing researchers to define and simulate custom gene regulatory networks, making it easier to test and compare hypotheses within a shared framework. Having all existing models for limb development together will empower users to explore, simulate, and challenge or build upon each other's work, promoting cumulative knowledge building.

"Our aim with LimbNET is to have everything in one place, so that the data, the models and the simulations are not scattered across research groups, countries and institutes," said Antoni Matyjaszkiewicz, first author of the work and Research Staff Scientist in EMBL's Sharpe Group. "The limb development community is not huge, so we feel like this is a realistic way of enhancing collaboration, transparency and empowerment for our peers to collectively advance in this field of research."

Caption: The authors of the work: Antoni Matyjaskiewicz (left) and James Sharpe (right). LimbNET is much more than a simple data repository. It is a new type of platform allowing researchers to define and simulate custom gene regulatory networks, making it easier to test and compare hypotheses within a shared framework.
Credit: Carla Manzanas/EMBL

Metabolic activities are not global modulators of developmental tempos

The Ebisuya Group showed how metabolic activities selectively modulate the segmentation clock, which varies depending on the species. The work, titled '*Metabolic activities are selective modulators for individual segmentation clock processes*', was published in the journal *Nature Communications*.



Caption: The segmentation clock is a group of genes that oscillate and regulate the periodic formation of certain structures in developing embryos. **Credits:** Daniela Velasco/EMBL

Miki Ebisuya, former Group Leader at EMBL Barcelona and now a professor at Physics of Life TU Dresden, and her group set out to determine whether metabolic activity serves as a global modulator of developmental tempo. Their findings revealed that, contrary to a preexisting hypothesis in the field, metabolism does not serve as the overarching modulator for developmental speed across species.

"Our work suggests that interspecies differences in developmental tempo cannot be attributed to a single principle, and instead result from the interplay of multiple principles," said Mitsuhiro Matsuda, Staff Member at TU Dresden and first author of the study.

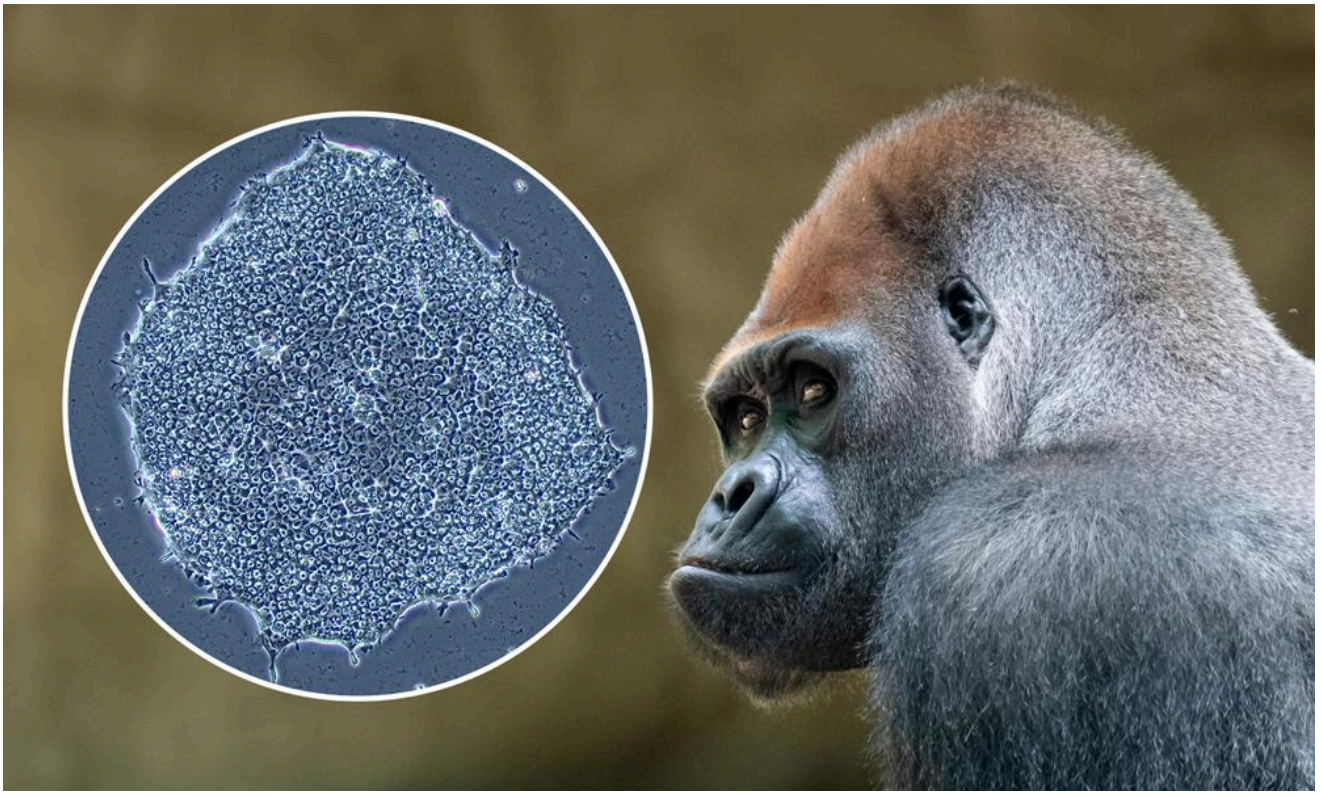
Scientific collaborations

The Barcelona CryoZoo secures funding from Revive&Restore foundation

The Barcelona CryoZoo project is an initiative dedicated to conservation and research aimed at protecting the biological diversity of our planet. The objective is to create a stable biobank of animal cell lines, giving priority to endangered species worldwide.

The Barcelona Zoo Foundation, the University Pompeu Fabra, the Barcelona Museum of Natural Sciences, and the European Molecular Biology Laboratory (EMBL) in Barcelona are the four partners of the Barcelona CryoZoo.

This year, this major collaborative effort received key competitive funding from the Revive & Restore foundation, a key funder that aims to preserve endangered species. Revive & Restore provides funds to researcher partners developing projects that translate advanced biotechnologies to wildlife conservation applications currently lacking viable solutions. The CryoZoo received a grant in the Stem Cell Technologies category for a project that leverages genomics to uncover transcription factors and advance iPSC generation for endangered species.



Caption: Gorilla cell lines were cryopreserved at the Barcelona CryoZoo. **Credits:** Barcelona Zoo, UPF, Creative Team/EMBL

Barcelona, Glasgow, and Malawi: united to stop cerebral malaria

The Bernabeu group studies cerebral malaria by building 3D human blood-brain-barrier (BBB) models. These models include several critical cell types present in the human BBB and are one of the most complete on-chip biological models to date.

Now, Maria Bernabeu, Group Leader at EMBL Barcelona, has established a triangular alliance that will take their work a step further. EMBL Barcelona, the University of Glasgow, and The Malawi-Liverpool-Wellcome Programme have teamed up to develop new tissue analysis tools to study preserved brain samples from deceased patients. This will allow the researchers to make a detailed map of all cell types and their disruption markers during cerebral malaria.

Together with Christopher Moxon's Lab at the University of Glasgow and in Malawi, the researchers will build an advanced 3D experimental model of brain blood vessels that includes immune cells and expose it to malaria-infected blood cells to track how damage occurs. Using powerful computational analysis with the help of Evangelia Petsalaki's Group at EMBL-EBI, they will compare findings from both real brain tissue and their on-chip model to develop a refined 3D model that matches what happens in patients.

This project is funded by a CaixaResearch Health grant.

Caption: Christopher Moxon (left) and Maria Bernabeu (right) in the PRBB campus. **Credits:** Carla Manzanas/EMBL

A public-private consortia to tackle the most aggressive lung cancer

The Dayton group will be a key partner in a research project focused on developing a new drug against the most common subtype of small-cell lung cancer (SCLC-A). The public-private consortia includes the following partners: Nuage Therapeutics, the Spanish National Cancer Research Centre (CNIO), the European Molecular Biology Laboratory in Barcelona (EMBL Barcelona), and the Vall d'Hebron Institute of Oncology (VHIO). The main objective of the project is to reach the clinical phase with a robust dataset demonstrating the efficacy and safety of the drug candidate NTX-A, which has been one of the primary focus of resources over the past year.

To do this, Nuage Therapeutics has secured €2.7 million in funding from the Spanish State Research Agency (AEI) of the Ministry of Science, Innovation and Universities under the R&D&I State Program for Transfer and Collaboration.

"We are very excited to be a key partner in this project and bring the expertise of organoid development that we have at EMBL Barcelona. It is through interdisciplinary partnerships like this one that we can effectively advance in the field of cancer research." said Talya Dayton, Group Leader at EMBL Barcelona.

Dayton and her group will lead the development of advanced laboratory models, called patient derived tumour organoids (PDTOs), that are grown directly from patients' tumour tissue to closely mimic real tumours. Once developed, the organoids will be classified by their molecular subtypes and ASCL1 status to test protein inhibitors and their ability to stop tumour growth. The effects of the drugs will be assessed against cell survival, gene activity, ASCL1 expression, and toxicity, helping the team identify the most effective and safest candidates for future preclinical development.

Caption: Talya Dayton, Group Leader at EMBL Barcelona. Her group leverages novel organoid models of neuroendocrine (NE) cells and tumours to recapitulate and dissect mechanisms of human disease including cancer initiation, progression, and drug response. **Credit:** Montserrat Coll Lladó/EMBL

The Barcelona Collaboratorium for Modelling and Predictive Biology

The Barcelona Collaboratorium for Modelling and Predictive Biology is Europe's hub for predictive biology. The Collaboratorium, joint initiative between EMBL Barcelona and the Centre for Genomic Regulation (CRG), brings together professionals from computational biology, theoretical biology, complex systems, and artificial intelligence to transform data into models, and models into discovery.

This year, the Collaboratorium welcomed a new Project Manager, Bastien Debiève, who is responsible for the smooth development of day-to-day activities.

Caption: The Collaboratorium is a hub for research and aims to bring together experts from different disciplines to work on modelling and predictive biology. **Credits**: EMBL

Seminar Series

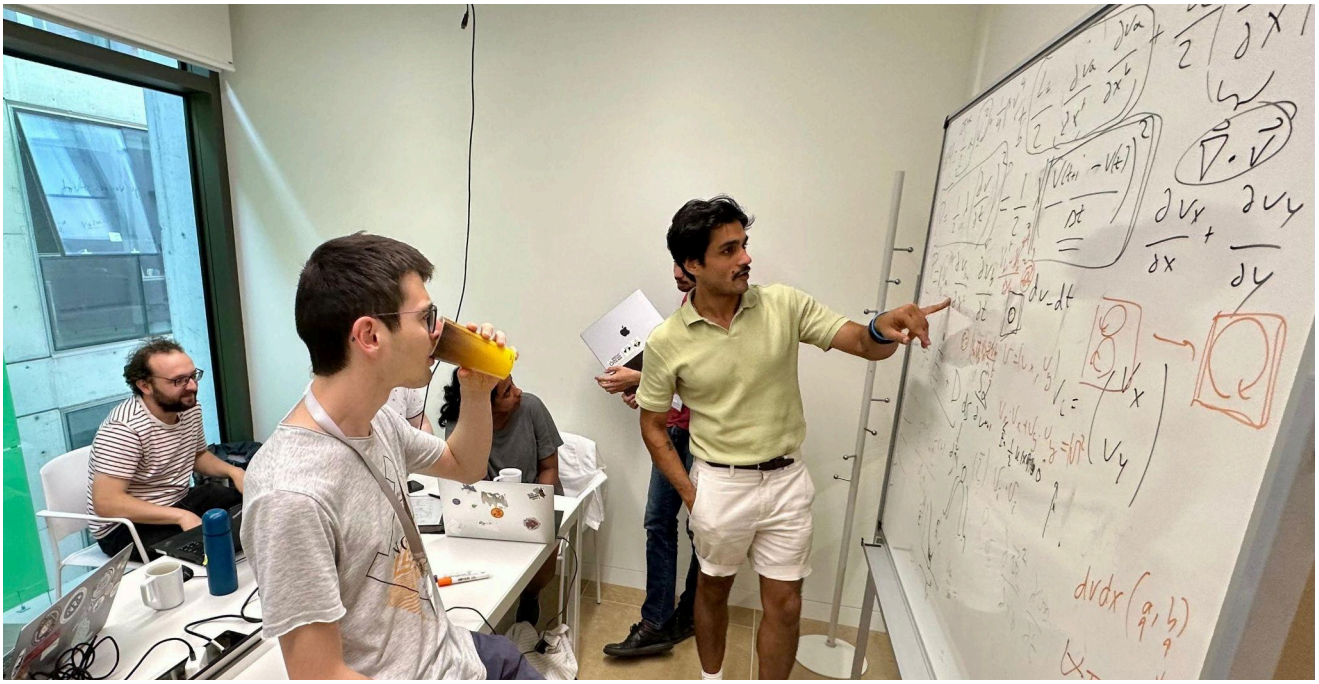
The Collaboratorium hosted **25 seminars** during 2025, featuring talks from distinguished researchers across a variety of disciplines. Highlights include seminars by Kim Sneppen (Niels Bohr Institute, University of Copenhagen, Denmark), Ramin Golestanian (Max Planck Institute for Dynamics and Self-Organization, Germany), and Nataša Pržulj (Barcelona Supercomputing Center, Spain). The seminar series of the Barcelona Collaboratorium is now an established weekly event, welcoming attendees from institutes across the city. It serves as a platform that brings together experts from the fields of computational, theoretical, and experimental biology.

Visitors

The Collaboratorium welcomed several visitors this year, including:

- **Balaji Prakash – Ahmedabad University, India:** Structural biologist and professor studying molecular mechanisms underlying biological systems

- **Sutapa Mukherjee – Flinders University, Australia:** Professor specialising in respiratory and sleep medicine, with a focus on sleep disorders and public health.
- **Arjendu Pattanayak – Carleton College, USA:** Theoretical physicist exploring dynamical systems, quantum complexity, and sustainability in science education.
- **Leander Goldbach – University of Vienna, Austria:** Researches how molecular constraints influence evolutionary dynamics using computational models.
- **Mirko Francesconi – University of Cambridge, United Kingdom:** Studies phenotypic variability using large-scale omics data and machine learning approaches.



Caption: The spirit of the Barcelona Collaboratorium is to create a space where researchers from different disciplines can share, exchange knowledge, and learn from each other to explore biological questions.
Credits: EMBL

Barcelona Collaboratorium Annual Symposium

10 – 11 November 2025

The 2025 Annual Symposium tackled '[Causality in biology & AI]'. The complexity of biology makes it hard to distinguish correlation from causation. In addition, the explosion of biological data and AI tools has led some to question the need for identifying causal relationships to achieve predictive power and make practical progress in biology. The Barcelona Collaboratorium Symposium focused on causal inference from different kinds of biological data and mathematical approaches, including the extent to which machine learning and AI tools can reveal causal relationships.

The list of speakers included Caroline Uhler (Broad Institute of MIT & Harvard), Denis Noble (University of Oxford), James DiFrisco (The Francis Crick Institute), and Ava Khamseh (University of Edinburgh)

Organisers: Gaudenz Danuser (Institute of Human Biology), Mafalda Dias (CRG), Nora Martínez Corral (CRG), and James Sharpe (EMBL Barcelona)

Barcelona Collaboratorium Summer School

15 – 20 June 2025

Building on the success of its previous edition, this year's practical course introduced the essentials of computational modelling of multicellular systems to newcomers to the field. It was a week of hands-on activities especially designed for experimentalists without prior computational experience.

The summer school welcomed 20 participants and more than 10 lecturers joining from 11 different countries.

This year, the curriculum was enriched with a new segment covering the basics of mathematics and programming through gene regulatory networks, responding to observed needs from the last course.

The focus of the summer course remained on the dynamics of multicellular systems, ranging from embryos to organoids. It comprehensively addressed both the biochemical aspects, such as pattern formation by gene regulatory networks, and tissue mechanics, exploring how collective cell movements drive tissue-level morphogenesis and organisation.

The week was structured to foster networking opportunities among students, teachers, and speakers, further enhancing the collaborative and immersive learning experience.

Caption: The second edition of the Barcelona Collaboratorium Summer School took place in June 2025 in Barcelona. **Credits**: EMBL

Training and development

PhDs, Postdocs and Technicians

EMBL Barcelona is home to around 100 people. Most of our members of personnel are PhD students and postdoctoral fellows, which makes our Unit a young and dynamic place to work.

With the aim of having a transparent culture and to drive change internally, EMBL Barcelona includes several internal groups that create initiatives and assess dynamics in our Unit.

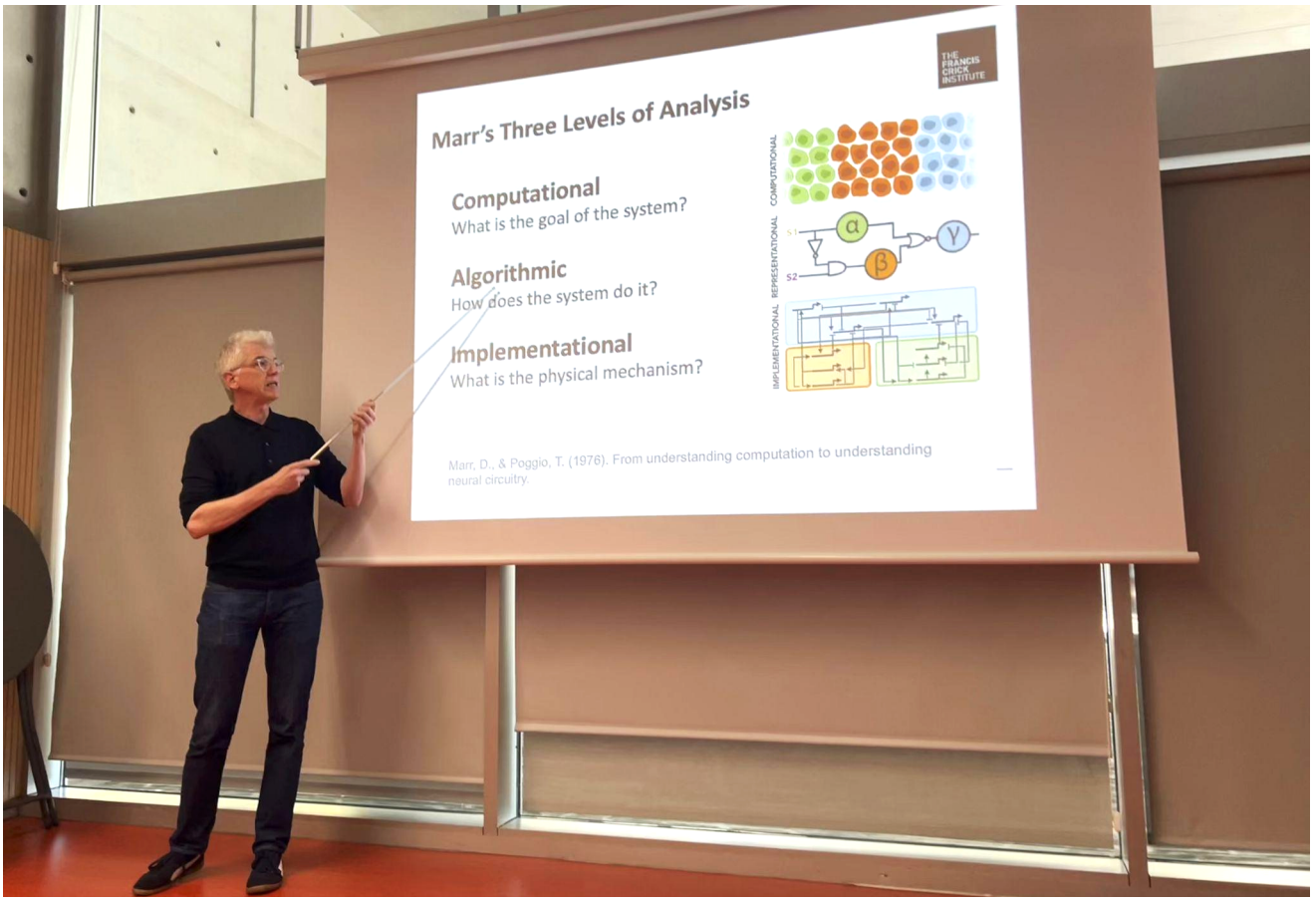
- PhD students organise monthly discussions around their projects, recently published papers, and day-to-day life to connect with other peers and colleagues from across EMBL Barcelona groups.

  In 2025, three PhD students from EMBL Barcelona successfully defended their theses, showcasing remarkable contributions to their respective fields. These are:

  - Rory Long (Bernabeu Group), 19 Feb 2025, ‘Wrapping Your Brain (Microvasculature) Around Cerebral Malaria: A 3D Brain Microvessel Model to Explore Pericyte Alteration and Angiopoietin/Tie-2 Dysregulation’
  - Akinola Akinbote (Haase Group), 11 Apr 2025, ‘Engineered Models of Human Microvasculature: Investigating the Cardiac Microenvironment’s Role in Vascular Remodelling’
  - Shuting Xu (Ebisuya/Trivedi Group), 17 Jun 2025, ‘Nuclear tangential rearrangements driven by adjacent radial fluctuations in species-specific neurodevelopment’

Caption: from left to right: Akinola Akinbota, Shuting Xu and Rory Long. **Credit**: EMBL

- Postdoctoral fellows manage the **Science by the Beach** seminar series. This is a special seminar series organised by EMBL Barcelona postdocs, inviting international speakers and open to the whole PRBB campus community. In 2025, the postdoc community invited the following speakers:
  - Francis Corson (Laboratoire de Physique de l'École Normale Supérieure, France), 18 Mar 2025, 'Mechanical self-organisation in development'
  - Harry McNamara (Yale University, USA), 13 May 2025, 'Decoding and controlling developmental self-organisation'
  - Yadira Soto-Feliciano (Massachusetts Institute of Technology, USA), 10 Jun 2025, 'Mechanism of gene regulation by chromatin adaptor proteins in health and disease'
  - Pavel Tomancak (Max Planck Institute of Molecular Cell Biology and Genetics, Germany), 16 Sep 2025, 'Origins of mechano-chemical feedbacks in evolution and development'
  - James Briscoe (The Francis Crick Institute, UK), 14 Oct 2025, 'The dynamics of spinal cord development'
  - Margherita Turco (Friedrich Miescher Institute, Switzerland), 18 Nov 2025, 'Organoid systems as a window into women's reproductive health'



Caption: James Briscoe from the Francis Crick Institute, during his seminar at 'Science by the Beach'.
Credits: EMBL

Solutions for the real world

2025 has been a year where several groups at EMBL Barcelona have thrived in translating their research efforts into solutions for the scientific community and society. Below, we present a summary of some technological developments

A human placenta-on-chip to protect pregnant women and their babies

The Haase Group was awarded a BioInnovation Institute (BII) foundation grant to support Model-MI – an *in vitro* model that mimics the maternal-fetal interface of the placenta. This model will allow for the study of molecule exchange and drug transport during pregnancy, a crucial issue for healthy development and gestation.

Despite ~4 million annual births in the European Union, there is a lack of knowledge regarding drug safety and development for pregnant women and foetuses. Many medications – especially those for pre-existing conditions – remain untested for this at-risk group, despite the often continued use of one or more medications during pregnancy.

BII has awarded the project team up to €3 million in funding for the next three years to develop a robust, validated, and market-ready tool.

Model-MI has the potential to transform the drug industry targeting women's health. A team is being established at BII in Copenhagen, led by Entrepreneur-in-Residence Pernille Singer, supported by Marta Cherubini (former EMBL postdoc) as Lead Scientist and Kristina Haase as PI of the project.

Caption: Kristina Haase (left) ,Group Leader at EMBL Barcelona and Principal Investigator of the project, and Marta Cherubini (right), Lead Scientist of Model-MI at the BioInnovation Institute in Copenhagen, Denmark.

Credit: Esteban Zoellner Olesen/BioInnovation Institute.

Engineered tips for sample handling

Patent number: EP2 338 3158.5

Matteo Bernardello from Trivedi Group developed a specially designed pipette tip that directs liquid flow so that delicate samples – such as tissues and organoids – are not destroyed in the process of media exchange. The invention is compatible with existing liquid-handling devices (both manual and automated) and also covers compatible kits and methods that use this tip to improve safe and controlled liquid handling.

Device for high-throughput gastruloids confinement and imaging of 3D samples

Patent number: EP25 382187.0

Nick Marschlich from the Trivedi Group developed a device that gently compresses 3D cellular samples in a controlled manner, enabling easier and more consistent imaging, as well as controlled mechanical confinement to measure how cells respond under these conditions.

The Mesoscopic Imaging Facility

The Mesoscopic Imaging Facility (MIF) provides access to advanced commercial and custom imaging platforms, offering high-resolution, 3D, and time-lapse imaging of biological tissues and organoids, with expert support for biology research and biomedical applications.

In 2025 the MIF, in collaboration with the Data Science Centre in Heidelberg recruited a data scientist, who will join the MIF in early 2026 and will help EMBL scientists gather and analyse data to design better experiments and improve processes.

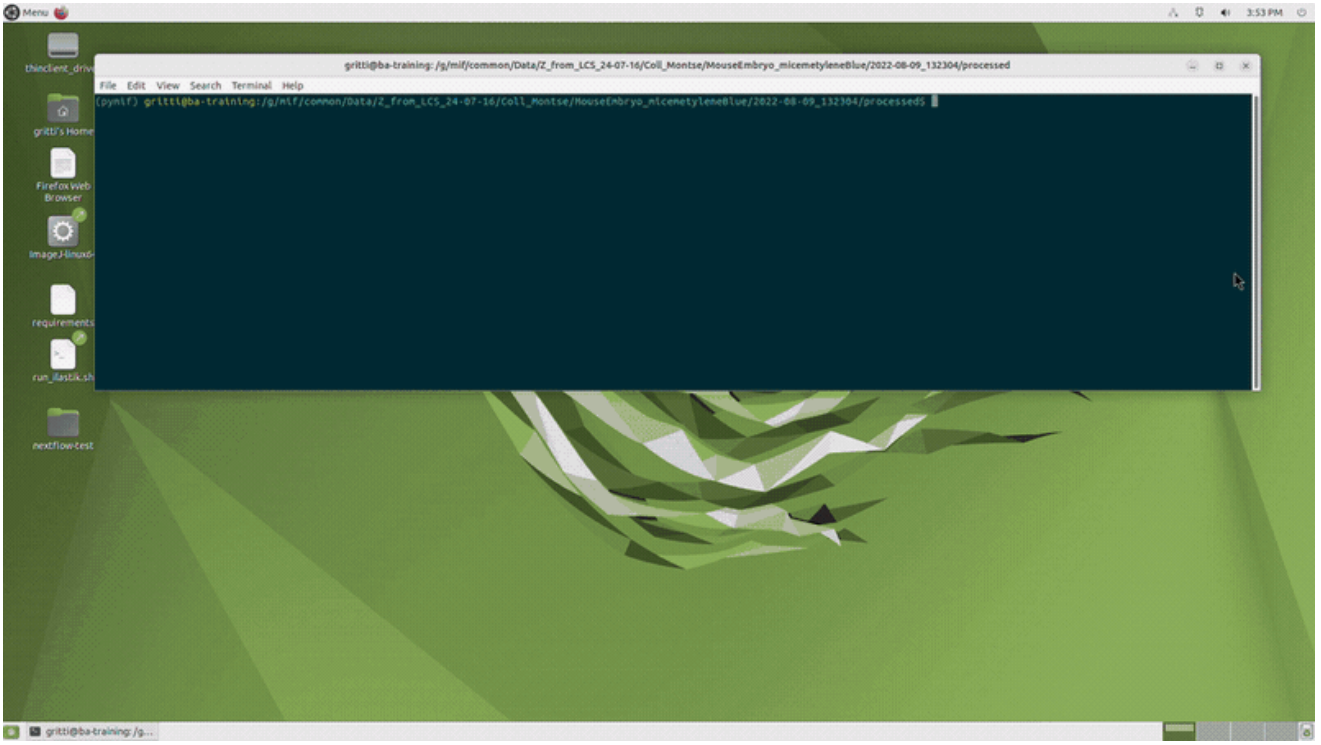
In 2025, the MIF had 39 registered users from 20 different groups.

PyMIF: a pipeline to standardise image formats across microscope platforms

Nicola Gritti, Bioimaging Project Manager at the MIF, has developed and established a pipeline that allows users to standardise image formats from a variety of microscopes. Each microscope has its own image format, which can pose a difficulty during image processing and analysis. Now, the MIF at EMBL Barcelona has developed a pipeline to standardise image formats from a variety of microscope platforms. This advancement helps convert all

image file formats from microscopes like Viventis, Luxendo, Opera PE, Zeiss, and others to the standard format ZARR. This format is ideal for metadata access and fast visualisation.

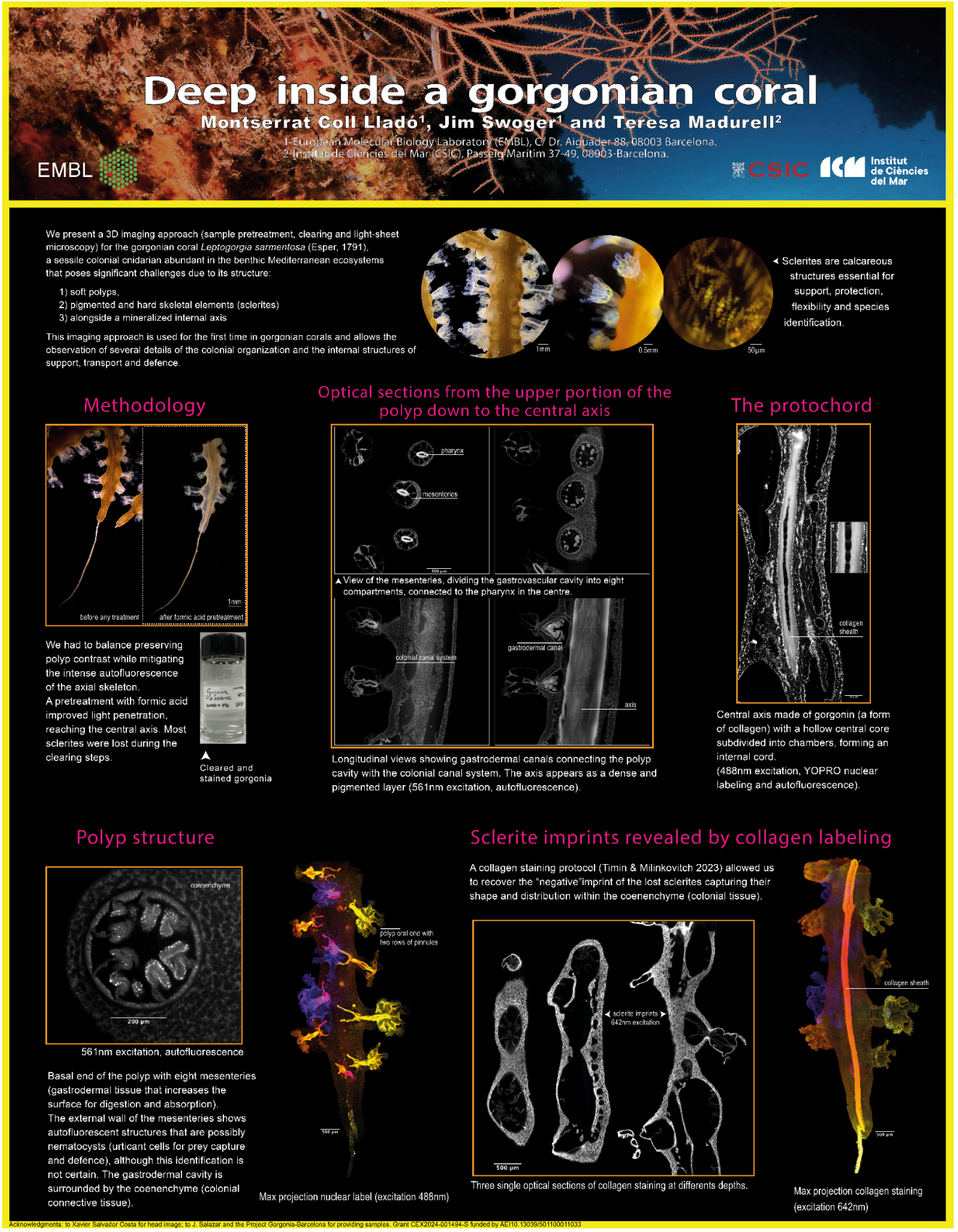
The pipeline is called **PyMIF** and is available as an open-source code. PyMIF is a modular Python package to read, visualise, and write multiscale (pyramidal) microscopy image data from microscope platforms available at the Mesoscopic Imaging Facility (MIF).



Deep inside a gorgonian coral

Montserrat Coll-Lladó, Mesoscopic Imaging Scientist at MIF, together with Teresa Madurell from the Marine Research Institute in Barcelona, won a best poster prize at the 25th international meeting of the European Light Microscopy Initiative that took place at EMBL Heidelberg.

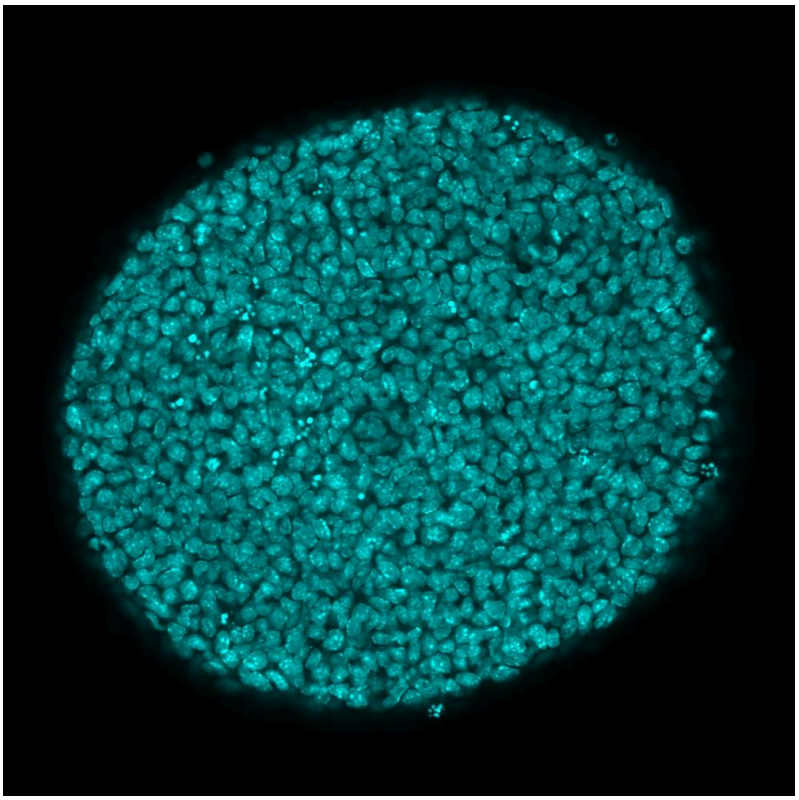
Their work presented a 3D imaging approach for the gorgonian coral *Leptogorgia sarmentosa*, a sessile colonial cnidarian that poses significant challenges for microscopy due to its structure.



Caption: Poster presented at the 25th international meeting of the European Light Microscopy **Credits:** Montserrat Coll-Lladó, Jim Swoger, Teresa Madurell

New equipment

Zeiss LSM 980 with Airyscan 2



In 2025, a new confocal microscope Zeiss LSM 980 with Airyscan 2 at the MIF became available to users. This piece of equipment can take extremely detailed images of cells and tissues. Compared to other confocals, this one is capable of collecting more light from the samples, which means higher resolution, cleaner images, and faster scanning.

This piece of equipment is crucial for EMBL Barcelona researchers, as it allows them to scan live samples at super resolution.

Caption: Gastruloid. Credits: Vanessa Weichselberger/EMBL

Seahorse XF Pro Analyzer

The Seahorse XF Pro Analyzer is a laboratory instrument that can measure how cells use energy. It analyses two key processes happening in the cells: how much oxygen cells are using and how much acid cells are releasing. By measuring these two things, researchers can understand how healthy cells' mitochondria are, how drugs or diseases affect cells, or why some cells break down sugar in different ways.

EuroBioImaging Virtual Pub

Jim Swoger, Head of MIF, was invited to give a talk to the EuroBioImaging Virtual Pub. The Virtual Pub is an online event that showcases the latest imaging technology developments, interesting applications of imaging, EuroBioImaging nodes' success stories and expertise.

Swoger's talk presented the efforts of EMBL Barcelona researchers to use a light-sheet microscope to optically write 3D fluorescent gradients into an intact sample. Although most current state-of-the-art spatial-omics techniques require physically sectioning the biological tissue of interest, and are therefore intrinsically 2D methods, for contemporary biology, 3D context of samples is key. Swoger presented his project 'Cell 3D Positioning by Optical encoding (C3PO)', by which researchers can write 3D fluorescence gradients into cells. After that, one can dissociate the tissue into a 2D plane and still be able to map each individual cell back to its 3D position on the sample with FACS and transcriptomics.

µFabLab: a makerspace for scientists

The µFabLab is an inter-institutional project, a space for collaboration and development of new micro-to-macro scaled tools located in PRBB. The project is promoted by EMBL Barcelona, CRG, UPF, and PRBB. The space itself is a "makerspace" for scientists, open to all employees of institutes within the PRBB. It is not a service, but rather a resource which researchers can use themselves to develop their own new devices and technologies, after being trained.

MIF and µFabLab: creating unique solutions

One of the perks of having in-house facilities is the freedom that researchers and experts have to come up with tailored solutions for unexpected problems.

Commercial microscopy equipment often has standard components and pieces that cannot be modified. However, Spyridon Bakas, Imaging Technology Specialist at MIF, and Roberto Paoli, µFabLab Lead Specialist, often team up to bring unique solutions to researchers.

In many cases, like for example for organoid imaging, users are limited by the way samples are mounted on the predesigned holders and inserts provided with microscopes, which may not meet their physical sample requirements or specific imaging needs. To address this, our scientists have been actively involved in designing custom holders based on user feedback. These holders offer novel solutions that can be applied across different systems, accommodating both cleared and live samples.

For cleared samples, specially tested clear resins have been used to produce holders and grabbers that are now the preferred choice across the facility's systems. Similarly, for live experiments, revisions to the original inserts have introduced compartmentalised designs

that allow researchers to image various conditions simultaneously within a single experiment.

Produced in the PRBB µFabLab, these designs are 3D printed using materials tested for durability when immersed in different imaging media, ensuring protection for both the sample and the microscope system while providing optimal positioning tailored to each experimental setup.

UPF/CRG Flow Cytometry Unit

The Flow Cytometry Unit is a UPF/CRG joint facility and provides to PRBB researchers technical expertise and training to access the state-of-the-art instrumentation, as well as technical and scientific advice to develop efficient and reliable flow cytometric assays with the highest quality control standards and productivity.

EMBL Barcelona has a strong connection with this facility, as our unit provided one of the high-performance pieces of equipment in it: the Thermofisher Big Foot cell sorter, a digital spectral and conventional cell sorter. This machine separates cells based on their physical or molecular characteristics. The device takes a mixed population of cells and sorts them into different groups, often one cell at a time, using lasers and detectors to identify exactly which cells have the features that are relevant for the researchers.

Making science happen

EMBL Barcelona's Operations and Administration team is dedicated to the success of the Unit and the smooth running of its daily operations.

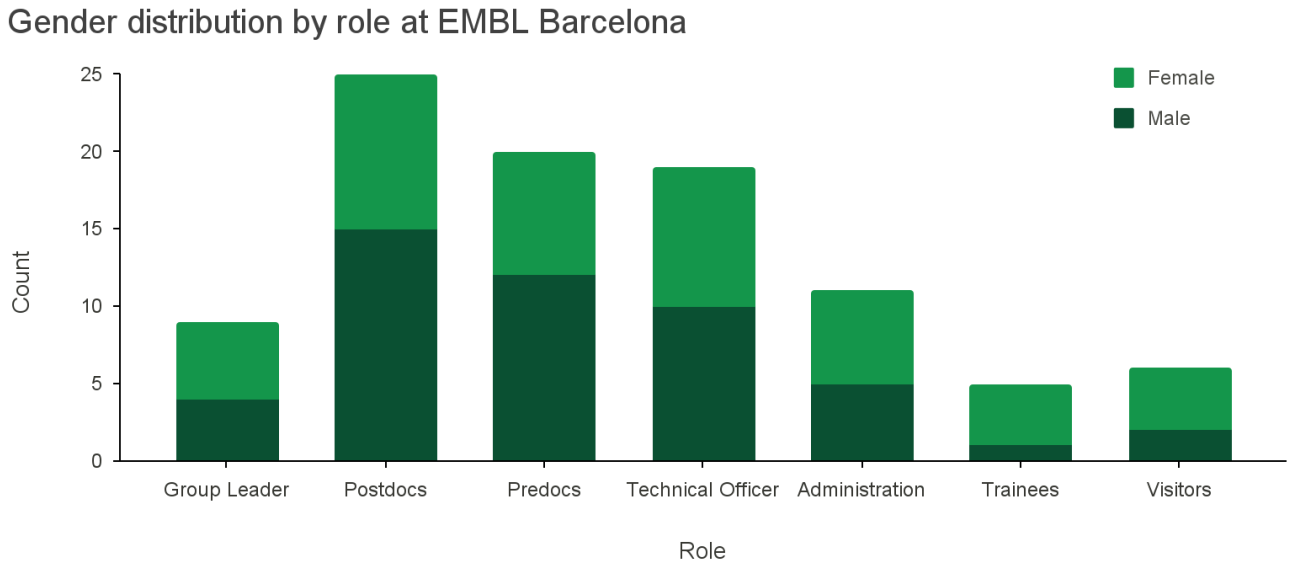
Strategic and operational support at EMBL Barcelona

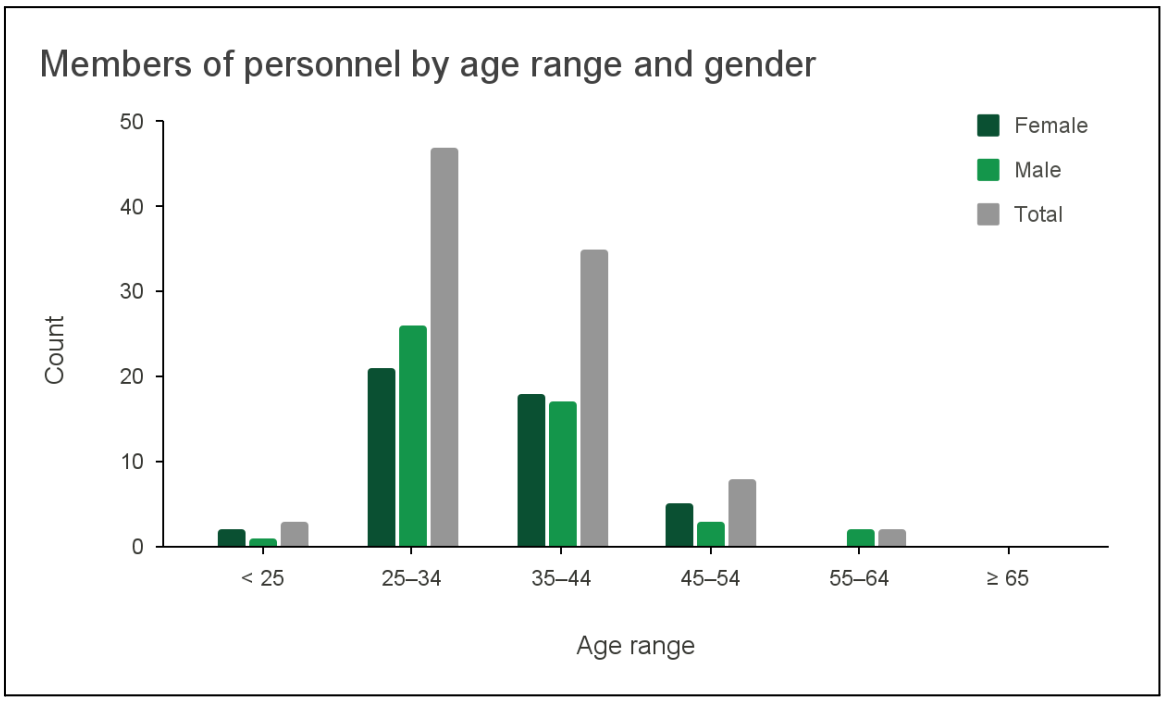
Behind the scientific achievements at EMBL Barcelona, there is a dedicated team of professionals who form the backbone of our institution. The Administration and Operations team ensures the smooth management of day-to-day functions, empowering our researchers to focus on their innovative work. Spanning key areas such as finance, grants management, health and safety, facility operations, IT support, human resources, events coordination, and communications, this team's expertise and commitment are vital to our success. This year, we have welcomed Laure Michelet as Administrative Officer and Michiel Korsten as Human Resources Partner.

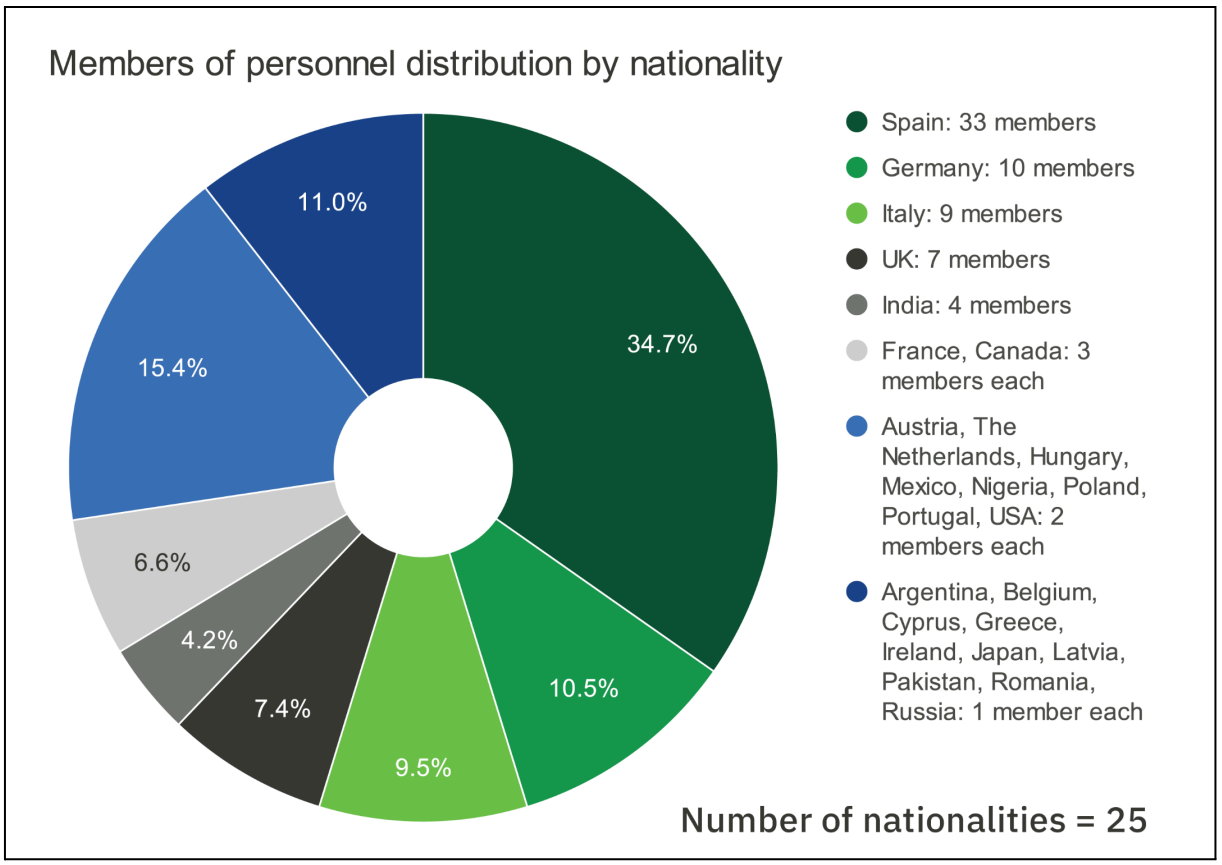
In 2025, EMBL Barcelona increased its involvement and integration in pan-EMBL activities and governance. The site has been part of key internal projects to develop a smooth matrix among departments and improve communication across sites, roles, and responsibilities. Among the direct benefits for our staff, it is worth highlighting the new ministerial passport stamp for non-EU nationals as well as the possibility for Spanish members of personnel to contribute to the national security system if desired.

Demographics

In 2025, EMBL Barcelona hosted 130 members of personnel throughout the year.




Members of personnel by age range and gender
Count
50
40
30
20
10
0
Female
Male
Total
< 25
25–34
35–44
45–54
55–64
≥ 65
Age range


Members of personnel distribution by nationality
34.7%
10.5%
9.5%
7.4%
4.2%
6.6%
15.4%
11.0%
Spain: 33 members
Germany: 10 members
Italy: 9 members
UK: 7 members
India: 4 members
France, Canada: 3 members each
Austria, The Netherlands, Hungary, Mexico, Nigeria, Poland, Portugal, USA: 2 members each
Argentina, Belgium, Cyprus, Greece, Ireland, Japan, Latvia, Pakistan, Romania, Russia: 1 member each
Number of nationalities = 25

EMBL Barcelona funds for 2025

In 2025, to ensure smooth research and operations performance, EMBL Barcelona managed a total amount of internal funds and competitive funds of €8,331,971.16.

The Purchase and Finance team smoothly managed the procurement needs of the site.

- **1,795 purchase orders** (POs) processed;
- **2,487 products and services, facility services, delivery services, and utilities**;
- **19 import transactions** from outside the EU;

This year's procurement activity reflects the administrative team's significant effort in securing the supplies and equipment necessary for EMBL Barcelona's continued excellence in scientific research.

Grants and awards

Grants and Funding in 2025

In 2025, EMBL Barcelona continued to excel in securing external funding, submitting **22 grant applications** and being successfully awarded **four grants**. These grants represent a significant achievement for the site, highlighting its excellence and the dedication of its scientists. The awarded grants include:

- **two grants from the Spanish Ministry;**
    - **Juan de la Cierva grant:** Gareth Moore, postdoctoral fellow at Trivedi group will bridge his knowledge in morphogen signalling and the expertise of the Trivedi group in self-organisation of multicellular systems to study development in stem-cell based embryo models
    - **The Public-Private Partnership Programme:** Nuage Therapeutics has secured €2.7 million in funding from the Spanish State Research Agency (AEI) of the Ministry of Science, Innovation and Universities under the R&D&I State Program for Transfer and Collaboration. The funding will support a research project focused on developing a new drug against the most common subtype of small-cell lung cancer (SCLC-A), in collaboration with the Spanish National Cancer Research Centre (CNIO), the European Molecular Biology Laboratory in Barcelona (EMBL Barcelona), and the Vall d'Hebron Institute of Oncology (VHIO).
- **one grant from the European Commission**, the prestigious MSCA Postdoctoral Fellowship, awarded to postdoctoral fellow Dorota Zawada from Haase Group. Zawada will develop the project VEAT-Chip, which aims at developing the first vascularised epicardial adipose tissue model on a chip, using vascularised human induced pluripotent stem cells.
- **one grant from La CaixaResearch Foundation**: This grant will allow researchers at the Bernabeu Group to make a detailed map of all cell types and their disruption markers during cerebral malaria.

Do it right and let it show

Communications: new year, new channels

EMBL Barcelona's communications efforts are aimed at highlighting the groundbreaking research that our groups perform. EMBL is Europe's life sciences laboratory, and EMBL Barcelona is positioning itself as a key institute in Europe for tissue engineering, organoid, and organ-on-chip technologies.

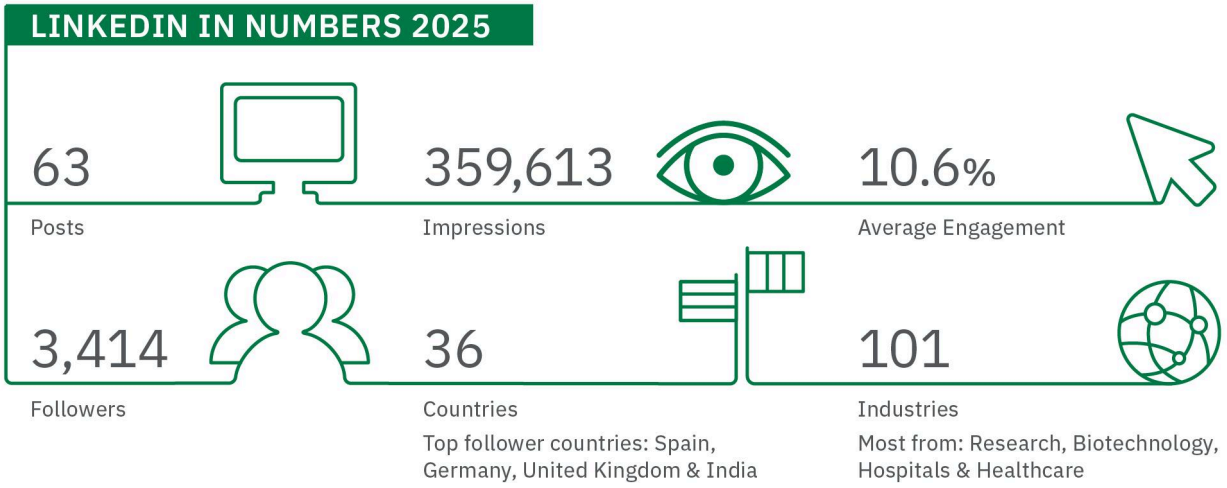
2025 has marked the execution of the strategic communication plan developed in 2024 to increase EMBL Barcelona's visibility locally and nationally. With a strong visual identity and a clear goal of making the site a strong hub for tissue biology and disease modelling, 2025 has focused on building upon this narrative. The Communications team at EMBL delivers integrated communications across a breadth of responsibilities including media engagement, social media management, and stakeholder engagement, among others.

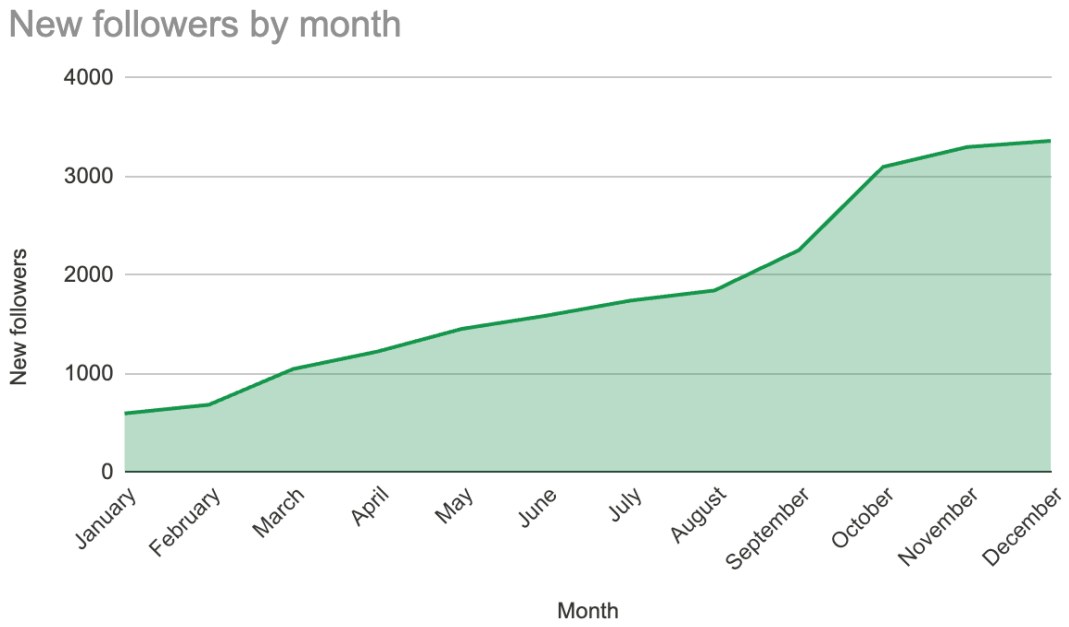
In January 2025, EMBL Barcelona opened a LinkedIn account to share scientific outputs, give visibility to our researchers, and engage with our partners throughout Europe.

LinkedIn Metrics

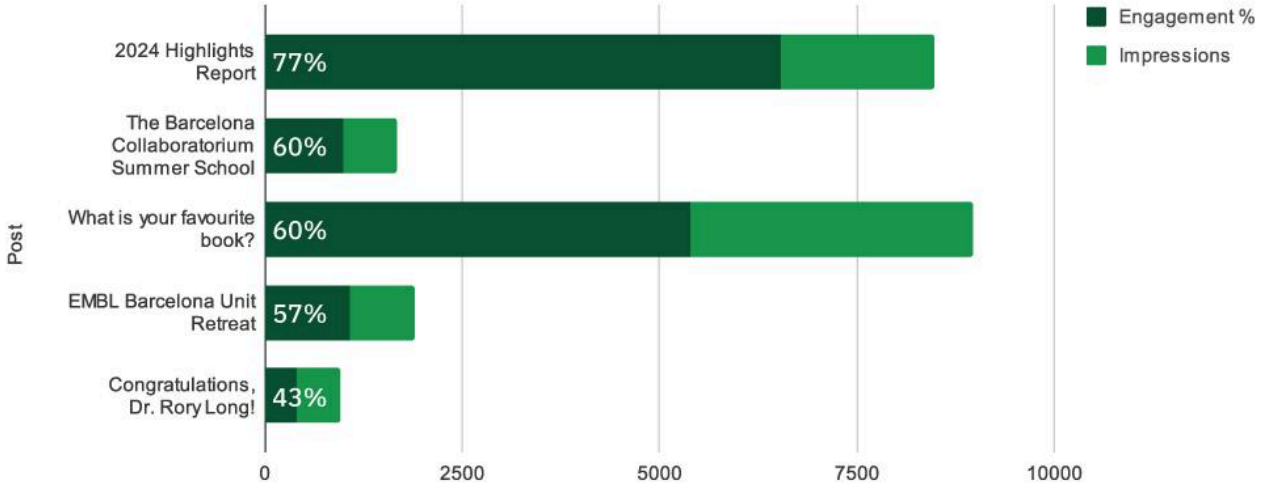
In less than a year, EMBL Barcelona's account has built a solid community of engaged followers, sharing scientific outputs and different activities at our Unit. Below is a summary of the main milestones of the first year of this account.

LinkedIn Activity Summary





Our best performing posts of 2025



Green EMBL

Sustainability Action Plan

Research is an activity that consumes a lot of resources, reagents, materials, water, and electricity. It also produces a lot of waste that is difficult to handle. In view of the current climate crisis, we have the obligation to take responsibility for the environmental footprint of our activities.

With this in mind and to respond to the challenge, EMBL has created:

- EMBL Sustainability office to reduce EMBL's environmental impact and promote sustainable science.
- The Sustainability Strategy, which focuses on how EMBL is transitioning to a sustainable organisation.

In 2025, EMBL Barcelona approved its sustainability action plan. This includes actions aimed at reducing the environmental footprint of our Unit Operations. The main pillars of the action plans are:

- Reduce waste: This includes better waste segregation, reduction of single-use items, and finding compostable alternatives
- Reduce CO2 footprint of on-site operations: This includes purchasing recycled paper hand towels, reducing document printing, and using sustainable catering suppliers, among other actions.
- Behavioural changes in the Unit: This pillar aims at raising awareness of the importance of reducing, reusing, and recycling among our colleagues at EMBL Barcelona. The Green EMBL group intends to organise training and workshops to improve individual carbon footprints in and outside the laboratory.

Beach cleaning

On 5 June 2025, we celebrated World Environment Day. To mark this occasion, colleagues from EMBL Barcelona went on a beach cleaning activity. EMBL Barcelona is located right in front of the Barcelona beach of Somorrostro, which sees a significant level of waste accumulation during the year.

At EMBL Barcelona, we marked the occasion of this day with a hands-on activity to contribute to our local environment. In 45 minutes, the teams collected over seven kilograms of waste, which were then appropriately disposed of.

Caption: EMBL Barcelona colleagues after collecting waste at the Somorrostro Beach. **Credit**: EMBL

Sustainability in Barcelona

The Barcelona Biomedical Research Park (PRBB) has an inter-institute sustainability group to discuss and approve measures for the entire campus. This year, this group started to recycle rigid plastic like that found in tip boxes and the caps of Pyrex glass bottles. The initiative started in May 2025, and the products are collected monthly by a social inclusion company.

In addition, as of 2025, all new vending coffee machines on campus now have the option to use one's own mug to reduce the use of single-use cups.

In April 2025, EMBL Heidelberg, together with EMBO, the Sustainable European Laboratories Network (SELs), and with support from the European Union's Climate Pact, organised the event 'Sustainable research: fit for the future'. The symposium tackled the critical role of sustainable practices within the scientific community and explored topics such as green laboratory practices, the inspiring role of grassroots movements, organisational sustainability strategies, and the vital role of funders, always with an eye on the future.

In Barcelona, IBEC organised a SELs satellite event where Alexandre Robert, Health and Safety Officer at EMBL Barcelona, participated in the round table ‘Interconnection between Health & Safety and Sustainability’.

Health and safety

EMBL Barcelona’s Biosafety Policy

Biosafety refers to the set of measures, operational practices, and controls to prevent and protect both humans and the environment from a potential unintended exposure and/or release of any biological agent.

The status of EMBL as an intergovernmental organisation gives our institution privileges and immunities to establish and implement its own rules and regulations in relation to Biosafety and Biosecurity. EMBL is nevertheless committed to cooperating with national, regional and local authorities and bodies.

This document describes the roles and responsibilities to keep EMBL Barcelona a safe working environment. In 2025, the Biosafety policy was updated, approved by EMBL’s Director General, endorsed by EMBL’s Standing Advisory Committee and acknowledged by the Catalan authorities.

A place for everyone

Community engagement at EMBL Barcelona

In 2025, EMBL Barcelona contributed to impactful initiatives within EMBL and the Barcelona Biomedical Research Park (PRBB), promoting inclusivity, respect, and accessibility across the scientific community.

Key activities and achievements

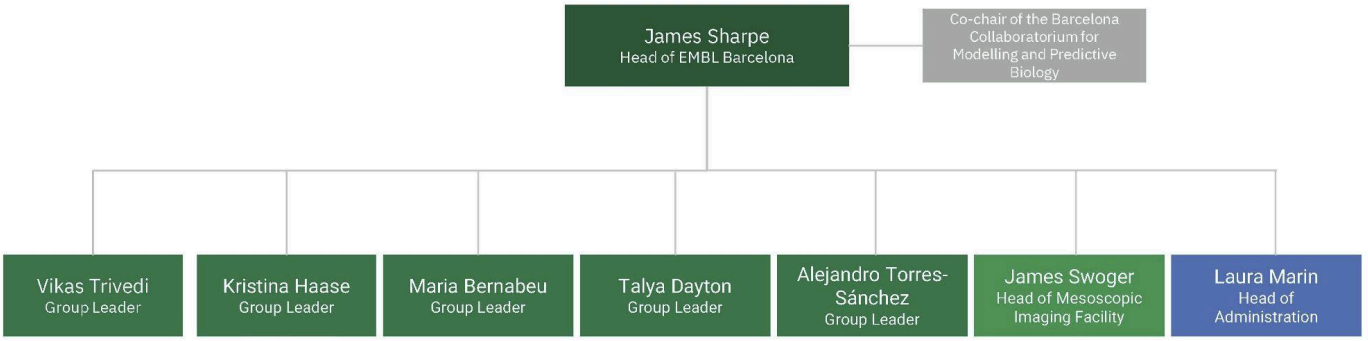
- **International Women's Day:** Heura Cardona, Lab Manager at the Sharpe Group, participated in a round table titled "Women in science: a world of possibilities" organised by the PRBB campus. Together with five colleagues from other research institutes, the group discussed the possibilities and hindrances that women experience during their scientific career.
- **What counts in science? Towards a more Responsible Research Assessment (RRA):** Daniel Santos Olivan, Computational Scientist at Torres-Sánchez Group, is part of the RRA Champions group at EMBL. The group shares a passion for responsible research assessment and is catalysing the adoption of RRA principles – such as those advocated by DORA and CoARA – by the EMBL community. This year, the group organised an internal event around meaningful ways to assess research. Panellists and attendees explored methods to better reflect the true value of scientific research.
- **Science Journalist for a day:** Arnau Fabra, ARISE Fellow at Torres-Sánchez Group, participated in an activity with primary school children aged 10, where he sent a short video explaining his research in computational biology, and the children prepared some questions to ask him a few weeks later. On 7th May 2025, the primary school pupils came to the PRBB and met with Fabra, engaging in a conversation around cell behaviour, software development, and disease modelling.
- **Open PRBB**: One of the strategic objectives of the PRBB research centres is to encourage scientific culture. We want to transmit scientific advances and knowledge to society and awaken inspiration and curiosity in young people and future scientists. EMBL Barcelona participated this year in the Open PRBB event across three main activities: a lab tour with the Dayton Group, where visitors could learn how organoids can help in cancer research; a microscopy activity by Montse Coll-Lladó from MIF to explore livie and fixed samples; and a talk by Silvia Sanz from the Bernabeu Group about cutting-edge projects on cerebral malaria.

Through active participation in public engagement activities, EMBL Barcelona continues to engage with society and the broader scientific community.

Caption: Montserrat Coll-Lladó, Imaging Specialist at the Mesoscopic Imaging Facility at EMBL Barcelona, co-organised an activity to show participants the power of microscopy. **Credit**: PRBB

EMBL Barcelona in numbers

EMBL Barcelona organisational chart



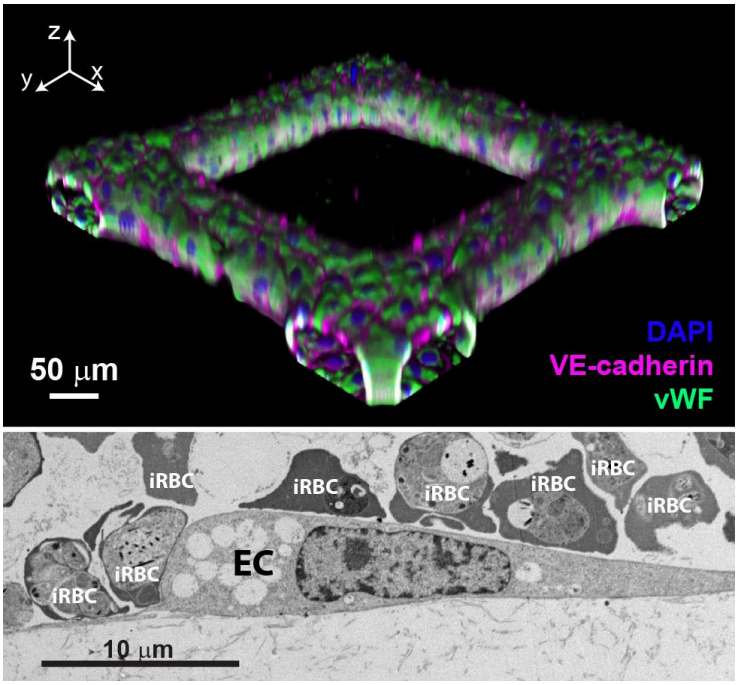
Research groups at EMBL Barcelona

EMBL Barcelona is currently home to seven dynamic research groups, each led by an accomplished group leader. Together, these laboratories cover a wide array of cutting-edge topics in tissue biology and disease modelling, using interdisciplinary approaches that combine molecular, cellular, and tissue-level insights. In 2026, a new research group led by Hannah Stuart will join EMBL Barcelona.

The Bernabeu Group

The Bernabeu Group explores how multicellular interactions influence the progression of cerebral malaria. Their research centres on developing an *in vitro* model of the human blood-brain barrier (BBB) to study the pathology of cerebral malaria and other infectious diseases. Key areas of focus include:

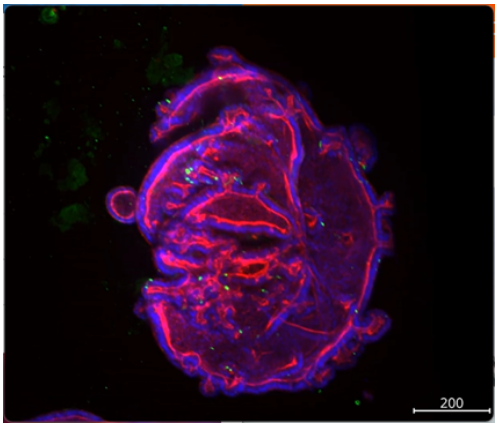
- modelling malaria's impact on the BBB using artificial vascular systems;
- investigating host-pathogen interactions in cerebral malaria with 3D BBB models;
- unravelling malaria parasite infection mechanisms through innovative BBB models;
- creating *in vitro* systems to examine malaria severity and tolerance.



Caption: Top: 3D reconstruction of 3D brain microvessels. Bottom: Ultrastructural imaging showing multiple *P. falciparum*-iRBCs binding to a primary human brain microvascular endothelial cell (EC) within the 3D brain microvessels. The major focus of the lab is to understand how *P. falciparum* mediates brain vascular damage. **Credit**: Bernabeu Group/EMBL

The Dayton Group

The Dayton Group examines the molecular, genetic, and environmental factors driving neuroendocrine cancer. By utilising 3D cultures of human pulmonary organoids, they aim to decode the complexities of these cancers. Their research includes:



- developing advanced organoid models for neuroendocrine tumours;
- studying the origins of neuroendocrine cancers using pulmonary and tumour organoids;
- understanding the processes that drive cancer development in neuroendocrine cells.

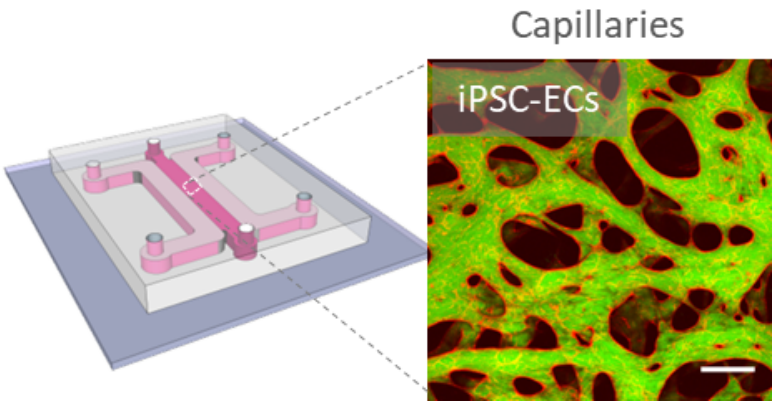
Caption: Image of an airway organoid.
Credit: Andrés Marco/EMBL

The Haase Group

The Haase Group focuses on understanding vascular development and the role of microvessels in human disease. They develop 3D *in vitro* vascular models to answer

fundamental questions related to sex and hormones, and to reveal novel therapeutic targets. Their work includes:

- Engineering tissue-specific human vascular models, in particular for cardiac, placenta, lung, and tumours (breast cancer and lymphomas);
- Developing new translationally relevant microfluidic platforms;
- Advancing imaging and analysis pipelines using deep learning approaches.

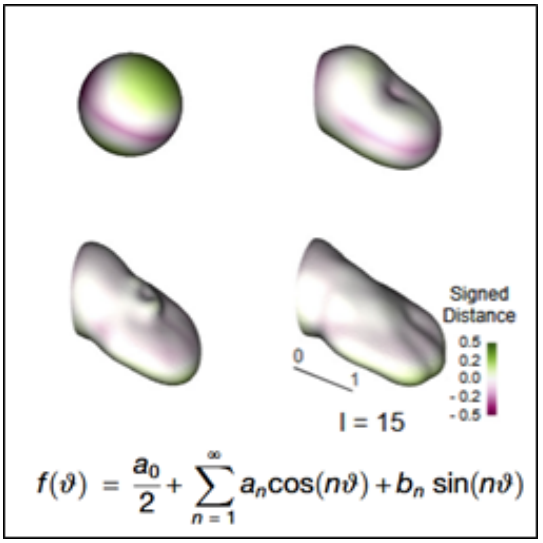


Caption: Illustration of an *in vitro* microfluidic platform that serves to investigate vascular pathology.
Credit: Haase Group

The Sharpe Group

The Sharpe Group applies systems biology to model organogenesis, focusing on how cells collectively shape tissues and organs – specifically limb development. Their computational and data-driven approaches include:

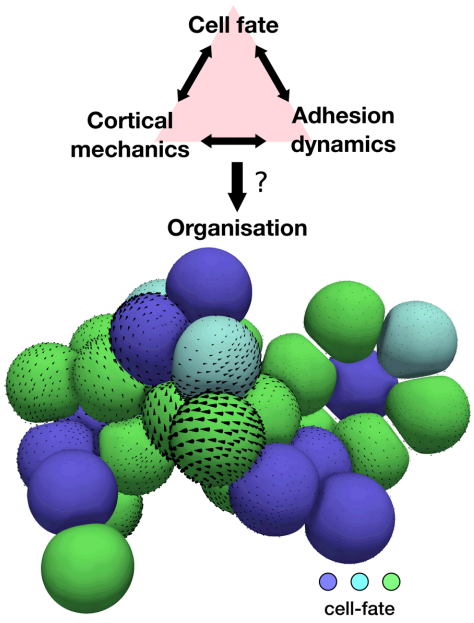
- developing predictive models of the gene regulatory networks that control vertebrate limb development;
- using computational tools to simulate 3D morphogenesis in mouse limbs;
- exploring reaction-diffusion systems and cellular processes to explain pattern formation.



Caption: Reconstruction of a limb using spherical harmonics.
Credit: Giovanni Dalmasso and Marco Musy/EMBL

The Torres-Sánchez Group

The Torres-Sánchez Group investigates the physical properties and dynamics of multicellular systems. They use computational simulations and mathematical modelling to understand tissue mechanics. Their work spans:

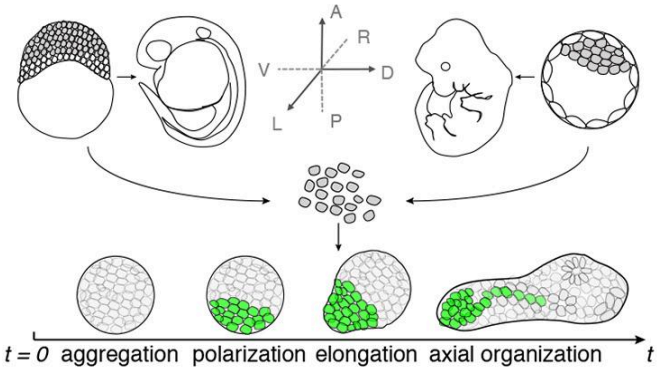


- creating predictive models of cellular systems from sub-cellular to tissue-scale dynamics;
- generating mathematical frameworks to study cell shapes and multicellular behaviours;
- developing models to explore endothelial and vascular biology through cell and tissue mechanics.

Credit: The Torres-Sánchez Group studies the interaction between cell mechanics, such as cortical flows, cell shape changes, or cell-adhesion dynamics, and cell-fate decisions, controlled by gene regulatory networks that lead to the organisation of embryos and organoids. **Credit**: Torres-Sánchez Group/EMBL

The Trivedi Group

The Trivedi group focuses on the mechanisms of self-organisation and cell fate changes in biological systems. Using *in vitro* stem cell models and interdisciplinary approaches, they explore:



- self-organisation and symmetry breaking in natural and artificial systems;
- early developmental processes in gastruloids, pescoids, and immune cells;
- integrating perspectives across experimental, theoretical, mechanical, and environmental factors.

Caption: Embryonic cells, when taken out of their embryonic context and allowed to self-organise in 3D, within homogeneously distributed signals, can generate body axes in a species-independent manner. This hints at a fundamental mode of development that underlies axial emergence in metazoan embryos. **Credit**: Trivedi Group/EMBL

Mesoscopic Imaging Facility

The Mesoscopic Imaging Facility (MIF) specialises in 3D imaging of biological tissues, enabling researchers to study the intricate structures and dynamics of organs and tissues over time. Using advanced techniques like selective plane illumination microscopy (SPIM) and optical projection tomography (OPT), MIF provides:

- high-resolution imaging for large biological samples;
- expertise in project planning, sample preparation, microscope training, and image processing.

Situated within the PRBB campus, the facility collaborates closely with EMBL researchers, visiting scientists, and neighbouring institutes, creating a hub for innovation in developmental biology and disease modelling.

Credit: The MIF works with techniques such as Selective Plane Illumination Microscopy (SPIM) and Optical Projection Tomography (OPT), which combine the ability to capture fine details with the capacity to study relatively large samples for extended periods of time. **Credit**: Kinga Lubowiecka/EMBL

µFabLab

The µFabLab is a collaborative makerspace where PRBB researchers can develop custom tools and prototypes for their experiments. This inter-institutional project, led by EMBL Barcelona in partnership with CRG, UPF, and PRBB, empowers scientists through rapid prototyping technologies. Access is granted after completing safety training, ensuring that researchers can independently design and fabricate devices tailored to their unique research needs.

Caption: The µFabLab is not a service, but rather a resource which researchers can use themselves (after being properly trained) to develop their own new devices and technologies. **Credit**: Kinga Lubowiecka/EMBL

Collaboratorium

The Barcelona Collaboratorium for Modelling and Predictive Biology is a joint initiative between EMBL Barcelona and CRG. It provides an open, collaborative space for experts in computational biology, theoretical modelling, and artificial intelligence to work together. By hosting extended visits, colloquia, and study programs, the Collaboratorium fosters interdisciplinary synergies to tackle challenges ranging from molecular biology to ecosystem prediction.

Administration and Operations

Behind the scientific endeavours at EMBL Barcelona is a dedicated Administration team, ensuring the smooth and efficient functioning of day-to-day operations. The team spans various departments, including finance, grants, health and safety, facility management, IT support, human resources, events, and communications.

By managing these essential areas, the team enables researchers to focus on their science while facilitating strategic collaborations and opening new opportunities. Additionally, the team provides personalised support for international staff, helping them navigate the complexities of relocating and integrating into a new environment. Whether assisting with documentation before arrival or addressing everyday challenges, EMBL Barcelona's Administration Team is a reliable partner in making science happen.

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