



Euro-BioImaging
European Research Infrastructure for Imaging Technologies in Biological
and Biomedical Sciences

WP8 Molecular Imaging

Task 8.2
Organize European community

Deliverable 8.4
Report on emerging technologies in molecular imaging with the potential
and demand to provide access

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1	<i>Executive summary</i>	3
2	<i>Introduction</i>	3
3	<i>About the deliverable and the work package/task</i>	3
3.1	Objective	3
3.2	Approach	3
3.3	Results	4
4	<i>Conclusion</i>	5

1 Executive summary

The aim of Euro-Biolmaging, a project on the roadmap of the European Strategy Forum on Research Infrastructures (ESFRI), is to provide scientists throughout Europe open access to state-of-the-art imaging technologies at all levels of biological and medical research, from bench to bedside. Within this project, WP8 deals with imaging technologies related to Molecular Imaging and will pave the way for implementing an integrated imaging infrastructure for both probe development and imaging technologies for molecular imaging, including multi-tracer and multi-modal molecular imaging applications in model animals as well as emerging tissue imaging technologies. In this way, this WP will bridge the gap between basic biological imaging and clinical medical imaging.

2 Introduction

To develop such a pan-European infrastructure for Molecular Imaging in a harmonized, coordinated and well-balanced way, an overview of (i) emerging Molecular Imaging technologies with the potential and demand to provide access, of (ii) existing and potential European infrastructure centres capable of providing access to Molecular Imaging technologies, and of (iii) the expectations, needs and requirements of all interested parties are required.

One important and effective way to gain insights in available infrastructures, emerging technologies and in the necessities desired by the research community is to survey the imaging community. Furthermore, relevant information on emerging technologies was and will continue to be collected at dedicated meetings of the imaging community, above all the Euro-Biolmaging Stakeholder Meetings and the European Molecular Imaging Meetings (EMIM) or the World Molecular Imaging Congresses (WMIC) for the specific field of Molecular Imaging.

This continuous community consultation ensures that Euro-Biolmaging keeps pace with changing trends and remains able to adjust to emerging technologies and also to changes in user needs in the biological, medical and molecular imaging communities.

3 About the deliverable and the work package/task

3.1 Objective

Analysis of the first Euro-Biolmaging stakeholder survey and of community consultations with regards to emerging technologies in molecular imaging with the potential and demand to provide access.

3.2 Approach

The stakeholder survey has been carried out as a common task off all scientific and technical work packages within Euro-Biolmaging. Overall, this survey aims to (i) identify the unmet needs and requirements of future users, (ii) acquire information for building-up an inventory map of existing imaging facilities and their training activities and (iii) collect information on funders' needs and views on European imaging infrastructure. Finally, the outcome of the

survey will help to define the work and business plan for the implementation of the Euro-Biolmaging research infrastructure by providing the data needed to describe the existing imaging infrastructure landscape in Europe and identifying the gaps for required imaging facilities to be newly constructed.

Consultations of the imaging community during dedicated conferences are particularly suited to gain insight into new and emerging developments within the field. Such consultations took place during the Euro-Biolmaging Stakeholder Meetings and dedicated imaging conferences, such as EMIM and WMIC, as well in national/regional meetings of the Molecular Imaging communities.

A more detailed description of the way the survey was carried out can be found in D8.6.

3.3 Results

3.3.1 Community consultations

Especially consultations of Euro-Biolmaging stakeholders gave insight into existing needs and requirements for the planned Research Infrastructure.

To serve at best the needs of the target scientific community, a European Molecular Imaging research infrastructure will have to provide access to multi-modality imaging facilities, to well-organized probe repertoires, to well-structured training and image analysis tools. The basic modalities have been identified in the survey (μ MRI up to 7T, μ MRI over to 7T, μ CT, μ PET, μ SPECT, μ US, BLI, OCT, OPT, FMT, μ PET/CT, μ MR/PET, PET/CT, SPECT/CT and MR/PET).

This deliverable deals with the identification of emerging technologies.

During the 3th Stakeholder Meeting in Heidelberg a strong need from the intravital microscopy community to be part of the Euro-Biolmaging roadmap became clear. 2/multiphoton microscopy and in vivo high-resolution microscopy are momentarily not represented within Euro-Biolmaging. However, these technologies are ideally suited to bridge the gap between biological (histology) and medical (patient) imaging as they range from subcellular over the tissue and organ level to whole body imaging. Key intravital microscopy modalities include optical coherence tomography, single-photon imaging, multiphoton fluorescence microscopy, second and third harmonic microscopy as well as intravital fluorescence lifetime imaging. For all these technologies, imaging contrast is greatly dependent on the characteristics of applied imaging probes. Furthermore, intravital imaging platforms often have integrated and dedicated animal imaging facilities (whole-body fluorescence and bioluminescence imaging, μ CT, μ PET, μ PET/CT, μ SPECT, μ SPECT/CT, μ US, μ MRI, μ MRI/PET) resulting in multidisciplinary imaging platforms with the potential to impact preclinical translational research and recent advances have been made in endoscopic and intraoperative clinical microscopy based on intravital techniques. All these features make intravital microscopy ideally fitting within Euro-Biolmaging WP8 (integrated multi-modal molecular imaging and probe development) in between the biological and medical WPs (WP6, 7 and WP9, 10 resp.). Currently, an inventory of intravital microscopy platforms within Europe is running.

Another emerging imaging technology identified during the 3th Stakeholder meeting is in vivo electron paramagnetic resonance imaging (EPRI). EPRI is an emerging magnetic resonance technique capable of detecting the spatial distribution of paramagnetic species such as free radicals probes and can give information on e.g. tissue redox status, pO₂, pH, and microviscosity. Within the Euro-Biolmaging roadmap in vivo EPRI, like intravital microscopy

located at the interface between preclinical and clinical imaging, will most probable be integrated within WP9.

3.3.2 Stakeholder survey

Within the first Euro-Biolmaging survey mainly state-of-the art molecular imaging techniques were included. Although these technologies are already widely available, there is still specific demand. In vivo EPRI was not included within the list of technologies and several survey participants indicated a specific need for access to this technology.

The most prominent emerging technology identified from the survey is the hybrid MR/PET technology, both μ MR/PET as well as clinical MR/PET. The potential of this hybrid modality appears strongly dependent on the combined use of properly designed imaging probes in order to provide a plus to the separate applications of PET and MRI.

Other emerging technologies are high-field μ MRI (over 7T) and fluorescence mediated tomography (FMT). For all these technologies there exists a high request from both users and providers and the user demand exceeds the availability (with the exception from high-field μ MRI. However, as pointed out in D8.6, also for this modality the most important reasons for Molecular Imaging infrastructure providers not to provide external access are the lack of instrument and personnel capacity).

A more in depth analysis of the survey can be found in D8.6.

4 Conclusion

Several emerging technologies within molecular imaging with the potential and demand to provide access have been identified. Of these technologies, intravital microscopy (currently not represented within Euro-Biolmaging) will be included within WP8 and in vivo EPRI within WP9. An inventory of intravital microscopy platforms within Europe is ongoing.