This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 713645.

BioMEP Quality Assurance Handbook

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 713645.

Content

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 713645.

1 BioMEP doctoral programme

BioMEP doctoral programme brings together complementary expertise of 7 leading European research groups in the field of Biomedical Engineering and Medical Physics and major private industrial companies and university hospitals (Figure 1). BioMEP aims to fulfill the demand for highly-qualified biomedical engineers and medical physicists addressing the needs of the academic, healthcare and industry sector, and thus to fully prepare them to meet the increasing demands of the European labor market. Together with the University of Eastern Finland (Finland), the following universities are participating in the project: Lund University (Sweden), University of Oulu (Finland), Aalto University (Finland), Tampere University of Technology (Finland), University of Turku (Finland) and Gabriele d'Annunzio University of Chieti-Pescara (Italy).

The BioMEP mission is to improve the welfare of the society through improvements in healthcare and supporting the strong industry sector of medical technology. It is the objective of BioMEP to fulfil the demand for highly-qualified scientists addressing the needs of academic, healthcare and industry sector, and thus to meet the increasing demands of the European labor market.

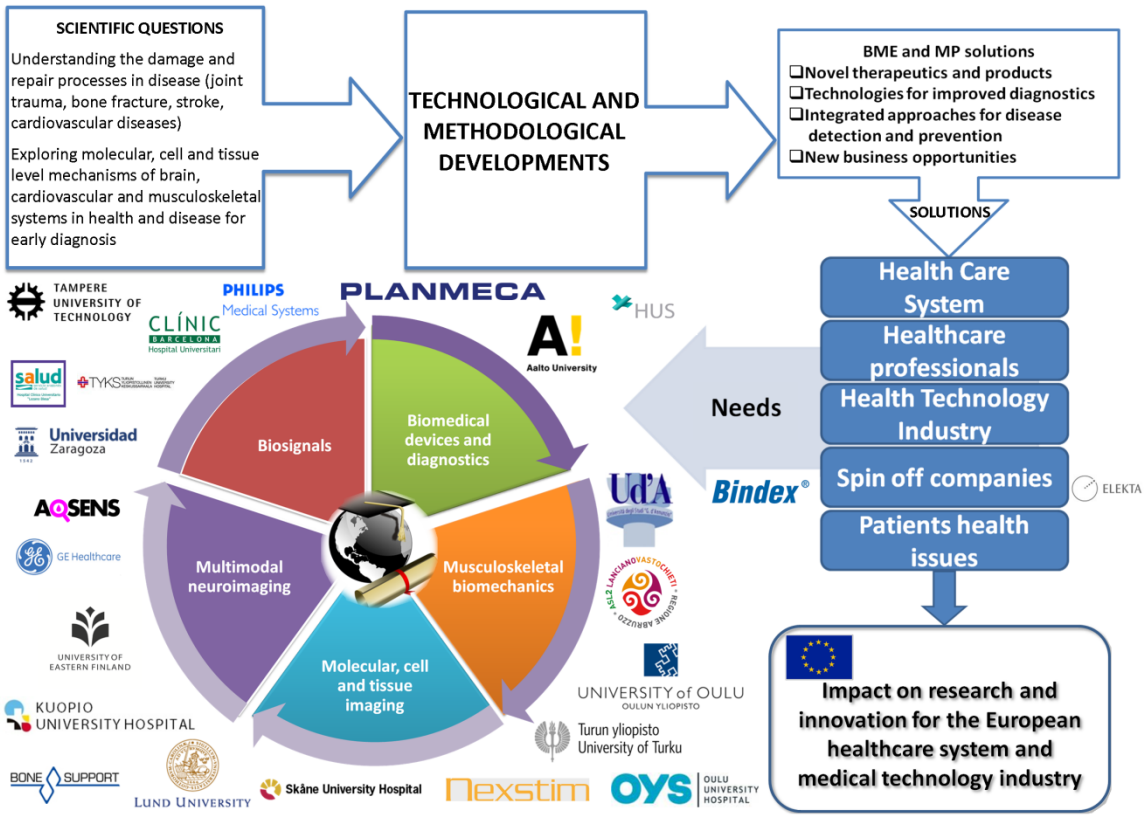

Figure 1. BioMEP combines research teams and collaborators (hospitals and private companies)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 713645.

with complementary expertise, methodologies and techniques needed to tackle together key scientific questions to address the needs and challenges of our society

The BioMEP research programme is divided into five separate but highly interconnected and interdisciplinary research focus areas:

Musculoskeletal biomechanics

Musculoskeletal biomechanics explores a broad range of medical issues related to the musculoskeletal system and orthopaedics, such as osteoarthritis and osteoporosis. Urgent scientific development in diagnostics and treatment of these diseases is needed to manage successfully the future health challenge. Developing innovative imaging techniques and computational tools is crucially important in understanding the mechanisms in osteoarthritis and osteoporosis. The research opportunities for Early-Stage Researchers (ESRs) are diverse and include interdisciplinary research topics that span from whole-joint mechanics and imaging, finite element modelling, human motion analysis, musculoskeletal adaptation, injury biomechanics to cell and tissue mechanobiology in the presence of both health and disease. To address these topics ESRs will use various methods and techniques for the characterization of joint tissues and their function at multiple length scales from the macro to the nano-level; novel modelling approaches at different length scales, human motion analysis, magnetic resonance imaging, computer tomography scanning electron microscopy, multiscale mechanical characterization, including nanoindentation and *in situ* mechanical testing.

Research groups involved in this research area are: Cell and tissue biomechanics http://luotain.uef.fi/?n=group&g=rami_group (UEF), Biosignal Analysis and Medical Imaging http://bsamig.uef.fi/ (UEF), Biomechanics http://bme.lth.se/research-pages/biomechanics/biomechanics/ (LU), Biomechanics http://www.oulu.fi/cse/bme/biomechanics-research-team (OULU). This research area is in close connection with *Molecular, cell and tissue imaging* research area.

Molecular, cell and tissue imaging

Molecular, cell and tissue imaging focuses on understanding how molecules, cells and tissues function and respond to external cues in normal and pathological states. Bridging scales from the nano- to the millimetre range with a temporal resolution of several seconds poses huge challenges for microscopy methods but also requires powerful computational approaches for data acquisition, processing and image analysis. The research opportunities for ESRs will include developments of various multimodal microscopy applications for both life science research and medical imaging applications such as: multiparameter and computer aided high content fluorescence imaging, combination of STimulated Emission Depletion (STED) and Ground State Depletion (GSD) with automated confocal High Content light Microscopy (HCM) and Fluorescence Lifetime Imaging Microscopy (FLIM), super resolution microscopy, Electron tomography (ET), integrated positron emission tomography scan with computed tomography (PET-CT), high resolution

tomographic imaging (micro-nano scale) and scattering (nanoscale), high resolution transmission electron microscopy (TEM), Fourier Transform Infrared spectroscopy, single-photon emission computed tomography (SPECT).

Research groups involved in this research area are: Cell and tissue biomechanics http://luotain.uef.fi/?n=group&g=rami_group (UEF), Biomechanics http://bme.lth.se/research-pages/biomechanics/biomechanics/ (LU), Laboratory of Biophysics http://www.biocity.turku.fi/research-programs/diagnostic-technologies-and-applications/ (UTU).

Biosignals

The analysis of biosignals has received a wide attention in research as well as commercially because novel signal processing techniques can lead to better and more timely diagnosis and treatment of different disorders (e.g. cardiovascular and neurological disorders). Biosignals recorded non-invasively from the human body convey information about the physiological systems generating them, but it is often hidden or blurred due to external and internal noise and other interacting signals. Signal processing is required to extract from biosignals the information which is physiologically/clinically relevant or meaningful. Proper signal processing techniques should be driven by the underlying physiology and application, and requires multidisciplinary knowledge. Research topics include for instance: automatic electrocardiogram (ECG) delineation and characterization for risk stratification and cardiac dysfunctions assessment, cardiovascular variability analysis for the assessment of autonomic nervous system in physiological and pathological conditions, intracardiac electrogram (EGM) characterization for guiding atrial fibrillation ablation, modeling and simulation of cardiac electrophysiology.

Research groups involved in this research area are: Biosignal Analysis and Medical Imaging http://bsamig.uef.fi/ (UEF), Biosignal processing http://www.oulu.fi/cse/bme/biosignal-processing-team (OULU), BioMediTech http://www.uta.fi/bmt/ (TUT), Biomedical Signal Interpretation & Computational Simulation http://diec.unizar.es/~laguna/personal/ (UNIZAR). This research area is connected with Multimodal neuroimaging research area.

Multimodal neuroimaging

Nowadays functional neuroimaging is becoming more and more important not only in basic neuroscience but also in the clinical field. Brain imaging techniques rely either on the reconstruction of neuronal currents from measurements of the electromagnetic field they generate outside the head, or on the indirect measurement of activity from hemodynamics. Both kinds of techniques have advantages and limitations. It is particularly useful to implement a multimodal approach combining and integrating different techniques such as functional Magnetic Resonance Imaging (fMRI), MagnetoEncephaloGraphy (MEG), High Density ElectroEncephaloGraphy (HDEEG), Transcranial Magnetic Stimulation (TMS), Near Infrared Spectroscopy (NIRS). This approach has proven to be extremely powerful in the reconstruction of sources of brain activity

and has recently been applied also to the study of brain connectivity, allowing characterizing brain network in the stationary as well as in the dynamic case. Other brain imaging techniques including various hybrid techniques that involve infrared spectroscopy (NIRS) as well as MRI-guided, high-intensity focused ultrasound (HIFU) can be used for bloodless brain surgery. ESRs will have the unique possibility of training and conducting research in the development of novel measuring procedures and data analysis methods for multimodal imaging, and in the clinical applications for instance in the diagnosis and treatment of several serious diseases, such as stroke, epilepsy, Parkinson's disease, depression and tinnitus. Research groups involved in this research area are: Institute for Advanced Biomedical Technologies www.itab.unich.it (UDA), Aalto Brain Centre http://brainscience.aalto.fi/en/ (AALTO).

Biomedical devices and diagnostics

The main objective is the development of accurate, timely, multi-modal diagnostic techniques that can detect medical problems earlier and inform therapeutic strategies and timely interventions within all aforementioned research focus areas. All BioMEP research groups will lead the development and implementation of new devices, technologies and strategies for prevention and monitoring different diseases and injuries, accurate diagnostics and novel treatments to continuously improve the healthcare system and medical technology sector. It will mainly target medical problems with highest burden on quality of life, economical cost and mortality, such as cardiovascular disease, musculoskeletal diseases, injuries and neurological conditions.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 713645.

2 Administration

The University of Eastern Finland (UEF) is in charge of the BioMEP -doctoral programme. The director is Professor Rami Korhonen (UEF) and will be supported by coordinator Siru Kaartinen, PhD and by administrative staff within the UEF. The Project Management Committee is the executive body responsible for the day-to-day coordination and general management of BioMEP, including implementation, monitoring and reporting.

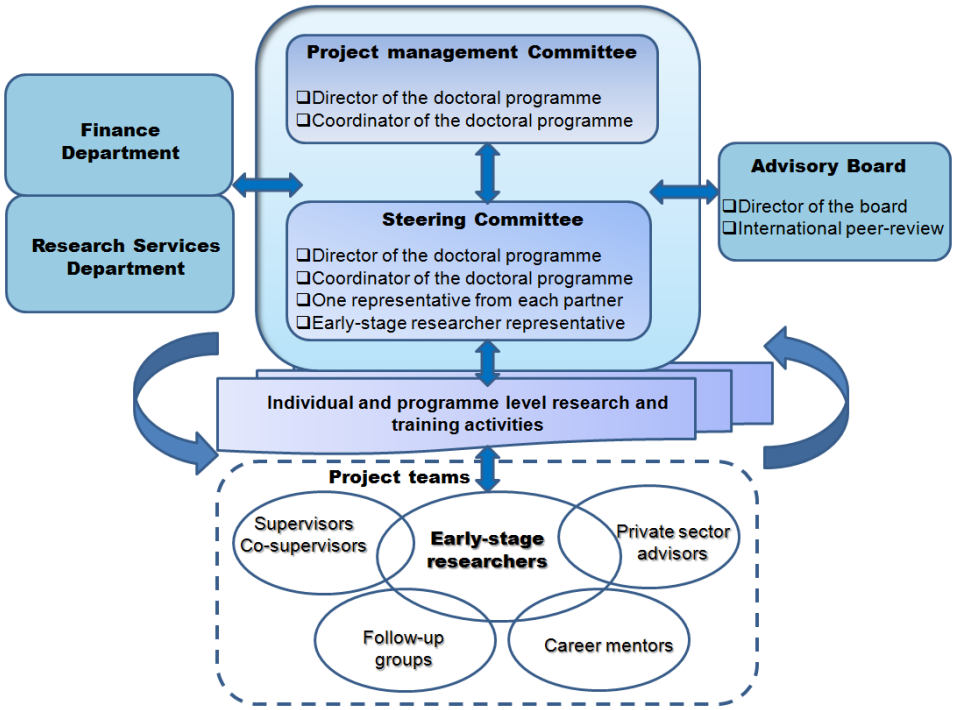

Figure 2. Overview of the BioMEP management structure

The Steering Committee (SC) will be responsible for strategic decisions concerning the programme. SC is comprised of representatives from each partner institution, the coordinator, plus the director of the programme. SC will also include one representative of the ESRs.

Members of the SC:
Director of the Programme Professor Rami Korhonen (University of Eastern Finland)
Coordinator of the Programme Siru Kaartinen, PhD (University of Eastern Finland)
Aalto University (Helsinki, Finland): Professor Risto Ilmoniemi
University of Turku (Turku, Finland): Professor Pekka Hänninen

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 713645.

Tampere University of Technology (Tampere, Finland): Professor Jari Hyttinen
University of Oulu (Oulu, Finland): Professor Timo Jämsä
University of Chieti-Pescara (Chieti-Pescara, Italy): Professor Gian Luca Romani
University of Lund (Lund, Sweden): Adjunct Professor Hanna Isaksson
University of Zaragoza (Zaragoza, Spain): Professor Pablo Laguna
Student member (will be selected later)

All BioMEP partners will have equal rights and responsibilities in research education. The director will chair the SC meeting and all decisions will be taken by a majority vote. A particular attention will be paid to Quality Control Management. A monitoring scheme will be implemented in order to assess the ESR's research project and training activities progress, using an electronic system of regular reporting from supervisors. The members of the SC meets at least once a year (twice in the first year of the project) in order to evaluate the status of the doctoral programme, to discuss about on-going research projects results and advice on the dissemination and exploitation potential and on ethical issues review and as well address matters raised by partners or by ESRs. Additional meetings can be proposed ad hoc as many times as necessary. The SC members will communicate on a regular basis as necessary by e-mail, phone or videoconferences. The scientific and administrative coordination of the individual research projects will be carried out by each project team from the hosting institutions involved.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 713645.

3 Employment of the doctoral students

Working conditions, institutional administrative support, and available services/facilities

Each ESR will be provided with an appropriate working place including computer and printing facilities, email account and access to state-of-the-art facilities, equipment and services of the hosting institution, such as laboratories, meeting rooms, restaurants, library etc. The IPR protection will be organized through the dedicated IPR teams from Research Service Units of each hosting university. Assistance with commercializing intellectual property arising from research (patenting, licensing, spin-off companies) will be provided for ESRs through the dedicated tech transfer office. Commercialization of the research finding will be promoted, ensuring the rights of the ESRs. A dedicated HR counsellor at the hosting university will provide assistance to the ESRs with national insurance registration, payroll and pension practices. In addition, ESRs will be given specific advice and assistance in terms of general career plans, and also practical information regarding the short and long term career opportunities in the host and abroad, preparing job applications, requesting recommendation letters and so on during their regular meetings with the supervisors. ESRs will be encouraged to join local and European Marie-Curie fellow associations which will allow them exchanging experience and enhancing their own network.

Employment conditions, including statutory working practices, social security coverage and social benefits

All ESRs will be offered full-time employment contracts. Working time and duties will be specified, in line with the hosting institution practices. The employment contract will involve social benefits including access to free public healthcare, social security insurance, pension scheme contributions, and parental leave, annual paid leave and the scheme of scientific leaves allowing travel to conferences and research visits. Depending on the ESRs interests, they might actively take part in the some administrative activities, organizing seminars and conferences, participating in the grant application process. In the beginning of the project, ESRs will be provided with materials from the hosting institution to facilitate their integration and familiarize them with the national and local research environment. They will also be given practical advice regarding the visa, working permits, accommodation, local language courses, and access to health services. Each of the ESRs will be assigned a main supervisor in the hosting institution to discuss the research and further career plans. The supervisor will offer advice on the best use of the travel funding, the choice of dissemination channels (journals, conferences, etc.) The supervisor will act as a first point of contact in case of any difficulties experienced by the ESR. In addition, an administration staff member will be nominated as a person responsible in practical matters assistance.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 713645.

4 Ethics

The Advisory Board has been foreseen to carry out the analysis of ethical aspects. The objective of this Board is to make sure that BioMEP does not support research which would be contrary to ethical principles, and also if the procedures to prevent ethical issues described in the project (including candidates' research project) are in agreement with the hosting institution ethical Policies. In any case Horizon 2020 rules on fundamental ethical issues, including those reflected in the Charter of Fundamental Rights of the European Union[1] will be followed and in case of conflict with the national/local ethical rules the Horizon 2020 rules will prevail.

All BioMEP partners agree to respect fundamental safety issues of good laboratory practices and of general practices involving the use and handling biological materials. All research will be conducted in compliance with national health and safety regulations. Additionally, the coordinator will ensure, through written confirmation and evidence, that all partners involved in research projects requiring ethical approval have been trained to Good Clinical Practice (GCP) standards, including familiarity with basic documents such as the EU Clinical Trials Directive (CTD2001/20) and the Declaration of Helsinki (WMA, 2008).

All research projects that envisage the use of animals will adhere to the national regulations on animal experiments and to the Directive 2010/63/EU on the Protection of Animals used for Scientific Purposes. The 3Rs policy of Refinement, Reduction and Replacement towards the use of animals for scientific procedures (99/167/EC: Council Decision of 25/1/99) will be adopted. Refinement is considered in the initial experimental planning, and the experiments are not considered painful for the animals. They are treated and euthanized according to all available guidelines. Moreover, the experiments are reduced so each animal can serve for several experiments, in order to further decrease the number of animals needed for each study. Wherever possible, we will attempt to reduce the number of animals. Power analysis will be conducted to identify the most suitable number of animals for the experiments. Alternative methods, such as computer models, will also be used to replace animal experiments whenever possible. However, they cannot completely replace the need for animal models. Whenever development or testing of methods is necessary, it will be conducted using animal tissue obtained from the local slaughterhouse to further reduce the number of animals. The experimental procedures will follow the FELASA recommendations and all animal procedures will be approved by the local ethical committees and will adhere to the national and international laws and provisions regarding the protection of animals.

All research projects that envisage the storage of patient and healthy subject data within established databases and the transfer of data between different partners in different countries will conform to all

[1] http://www.europarl.europa.eu/charter/default_en.htm

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 713645.

relevant data protection legislation within each individual country. In this way, transfer of data between countries will always be in observance of the data protection acts of both the sending and receiving countries. All partners within BioMEP will follow all legislation within each appropriate country and will register their projects with their national Data Protection Agency or equivalent.

Ethics and scientific practice

ESRs will respect the fundamental ethical principles, scientific practice and national and international regulations concerning ethical issues in research. The ESRs are expected to follow BioMEP defined rules related to academic integrity, which prohibits all forms of academic dishonesty, including cheating, fabrication, and plagiarism and aiding and abetting of a dishonest act. Research findings should be published in an open, transparent and accurate manner, at the earliest possible time, unless intellectual property considerations justify delay. All authors, unless otherwise specified, should be fully responsible for the content of publication. Guest authorship and ghost authorship are not acceptable. The criteria for establishing the sequence of authors should be agreed by all, ideally at the start of the project. Contributions by collaborators and assistants should be acknowledged, with their permission. All authors should declare any conflict of interest. Intellectual contributions of others should be acknowledged and correctly cited. Honesty and accuracy should be maintained in communication with the public and the popular media. Financial and other support for research should be acknowledged. All research activities in Horizon 2020 must respect fundamental ethics principles, including those reflected in the Charter of Fundamental Rights of the European Union and the relevant ethics rules of H2020.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 713645.

5 Career Guidance and Training

Supervision arrangement

All BioMEP partners have agreed to apply the same standardized supervision and monitoring scheme. For each ESR, one senior researcher performing successful research in BME or/and MP will be nominated as primary supervisor. To enable a balanced and broad, but at the same time in-depth training of the ESRs and to promote the knowledge transfer between the partners, one or more co-supervisors from the same or different partner institutions can be also nominated. Nominating postdoctoral fellows as co-supervisors will be strongly encouraged to promote postdoctoral training within BioMEP. Multidisciplinarity will be thus promoted by having co-supervisors from different backgrounds (e.g. physics, medicine, biology, and engineering). All the supervisors in BioMEP have internationally acknowledged expertise in their research field and all have experience in directly supervising or co-supervising ESRs. They have a proven track-record of high-impact scientific publications; regular roles in international conferences, journal reviews and grant application, as well as successful collaboration with hospitals and health technology industry.

Additional support will be provided through the mentoring and career development instruments of the local doctoral training program/school at most partner universities and through integration of ESRs into the local research groups. Moreover, each ESR will be seconded for duration of at least 3 months to the laboratory of the co-supervisor/academic or industry collaborator as part of the collaborative research effort. During the secondments the co-supervisor will oversee the progress of the ESR's training and research in coordination with the primary supervisor. The ESRs will also be provided with local educational resources at the partner institution (courses, lectures, seminars).

The roles of the supervisors, follow-up groups and mentors within the doctoral programme are an essential part of the career development support offered to all our ESRs. Principal supervisor together with co-supervisor will offer advice and guidance to the ESR towards the completion of the PhD degree. Working with the ESRs, they will help them to prepare appropriate ambitious personal Career Development Plans and will provide feedback on the research work progress, on the writing of scientific research articles and on presentations of the research results in seminars. ESRs will be encouraged to incorporate international mobility into their plans. All Career Development Plans will be reviewed and evaluated by the Steering Committee. The primary supervisor will take full responsibility for the overall management of the ESRs training and research project. The ESRs will have regular meetings with their principal supervisors, from a daily to weekly basis depending on the needs. In addition, the co-supervisors from other institutions will be fully committed to be available on a continuous basis by email and phone in order to assess progress, share information and develop ideas. Towards the end of the studies the supervisor and co-supervisor will discuss with ESRs on future career options and help to evaluate subsequent employment possibilities. The ESRs will be part of one local research group, where monitoring tools for the individual research projects and training will be in place, such as regular presentation in group seminars and written reports. The quality and

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 713645.

efficacy of the supervision and progress of each ESRs will be monitored and assessed annually by a follow-up group (2 senior scientists). The follow-up group members shall be appointed based on the proposals made by the principal supervisor and the ESR. Group members should be able to provide expertise that complements and expands on that of the supervisor. A written annual report describing the progress achieved over the last year will be prepared by ESR. The follow-up group will act as a valuable board for discussion of ideas emerging in the research; will provide constructive feedback and advice on future career options. And in cases where relationships with the supervisor are less than ideal, they can provide advice, mentoring, and if necessary, problem-solving mediation.

Additionally, ESRs will have the opportunity to take part in a career mentoring programme. Mentors will be graduates from the previous iBioMEP doctoral programme and working in different positions in the private/public sectors and also in academia. The ESRs will be able to choose their mentor from the alumni network of the doctoral programme based on their career interests and goals. Through the mentoring activities, ESRs will learn from the professional experiences of their mentors gaining insights into their careers perspectives and professional life.

Training

The training programme will provide ESRs with research and personal skills necessary to be successful in their research project and their future careers in emerging areas of BME and MP in academic, industrial or medical setting. ESRs will not only develop their research competencies in their particular cutting-edge research projects, but also will gain experience in their research setting and become familiar with the broad valuable international research network that surrounds the project. Their interdisciplinary training will be enriched by their hands-on experience in their particular cutting-edge research project and by the constant exchange of knowledge with other ESRs during annual meetings, summer schools and secondments.

The structure of the BioMEP training programme will be built upon the European Higher Education Area principles, thus facilitating harmonization and leading to comparable degrees based on European Credit Transfer and Accumulation System (ECTS). This will allow mutual recognition and increased ESRs mobility. The research activities of BioMEP cover a broad spectrum that ranges from the study of basic biomedical processes to the diagnosis and treatment of diseases, and thus, the training of the ESRs will be broad.

The training programme will consist of host-based and programme-level training aiming both at broad, specialized and complementary skills, and including transfer of knowledge between ESRs, their supervisors and co-supervisors from academia, industry and hospitals:

- host-based training through individual level activities at the hosting partner combined with secondments/internships and research visits
- programme level training: annual seminars, summer schools, BME/MP core courses, specialized courses, internet-based instruments, transferable skills courses and promoting mobility and interaction among the participating researchers.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 713645.

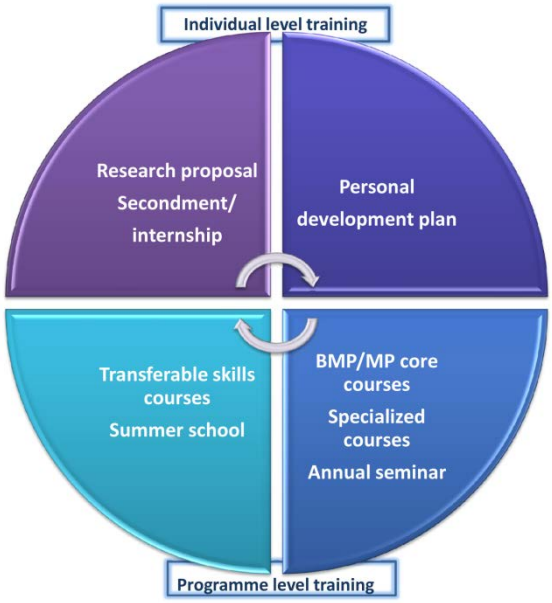

Figure 3. Training strategy delivered through activities at the individual and programme levels.

At the individual level, the ESRs will be encouraged to develop their own research project and training profile. High-quality supervised training through research of ESRs will be primarily conducted in the multidisciplinary research groups. In the beginning, each ESR will agree on a personal Career Development Plan with the supervisor and co-supervisor, covering research project proposal, scientific objectives, and schedule of envisaged courses, secondments and as well long-term career planning. Each ESR will be expected to have at least one secondment/internship to another partner organization and/or private sector collaborator. The secondments will be strongly promoted throughout the doctoral network. For instance, both theoretical and practical training in hospital environment will be included, especially for those aiming at working in hospital (primarily hospital physicists) to obtain readiness and qualification for clinically oriented tasks. These secondments will provide our ESRs complementary know-how on the research project, powerful motivation as they will understand the real-world applicability of their research and will facilitate the transfer of knowledge throughout the network. Research projects spanning all levels, from basic research to clinical implementation, will be addressed throughout the collaboration between the supervisors and ESRs with diverse backgrounds, including medical physics, biomedical, electrical and mechanical engineering, and biology, physiology and medicine.

Local scientific training will be supported by the local research groups at the participating institution and supplemented by additional scientific and transferable skills provided by local doctoral schools and staff development/training programmes (e.g. Regular seminar series and discussion meetings in the local research groups, where ESRs can present the results of their research will be important elements of local supervision and scientific training. In addition, practical courses will be organized locally, in which the ESRs will receive hands-on training in the laboratory in the experimental and computational techniques relevant

to their research. ESRs may also attend courses offered by other doctoral programmes/education networks as justified by the research focus and/or the Career Development Plan of the ESR. At the end of their research project, the ESRs will prepare a doctoral thesis typically consisting of multiple scientific journal articles that have undergone a peer-review process. Thus, the ESR will obtain the skills for scientific writing and become familiar with the review process. Instead of emphasizing the number of articles in the thesis, attention will be paid to the scientific quality. The detailed requirements for the composition of the doctoral thesis will be defined by the graduate schools of each participating institution. The doctoral programme culminates in a doctoral dissertation representing the results of the cutting-edge research project of each ESR compiled in a thesis that is defended in an oral examination.

In addition to the doctoral dissertation, the ESRs will typically need to acquire ~40 study credits (ECTS), depending on the specific requirements of the hosting university in order to obtain a doctoral degree. These studies will include an individual selection of specialized studies in different sub-areas within BME and MP, a set of BME and MP core courses intended for all ESRs of BioMEP doctoral programme and transferrable skills courses.

At the programme level, BioMEP will provide training activities in the field of BM and MP at the highest quality level comprising of a series of events such as workshops, summer schools and a collection of national and international courses. Thus, the ESRs will benefit from the opportunities derived from the participation in the BioMEP beyond what each partner institution will provide individually. Several courses have been and will be organized jointly in collaboration with other relevant doctoral programmes/education networks when applicable (e.g. Infotech Oulu Doctoral Programme, National Doctoral Programme of Musculoskeletal Disorders and Biomaterials, Graduate School in Electronics, Telecommunications and Automation, Graduate School of Modern Optics and Photonics, The Finnish Graduate School of Neuroscience). Additionally, the Finnish Society of Medical Physics and Biomedical Engineering (LFTY) strongly support doctoral education by organizing joint scientific and educational events. These training activities will be open to external researchers from academia or the public sector where relevant. This will provide the ESRs good opportunities for enhanced multidisciplinary connections.

Specific training activities are planned throughout the doctoral programme and are described in brief below:

BME/MP core courses will be arranged in the key topics of BME as 4-5 days intensive courses. The core courses will be organized periodically during the first 2-3 years. Internationally recognized experts will be invited as guest lecturers.

A variety of specialized courses (4-5 per year, 1-5 ECTS each) will be organized in different subtopics in BME and MP. The aim is to obtain deep understanding on the sub-area related to own research focus, or to broaden the knowledge of those working in other sub-areas. Internationally high-ranking lecturers will be invited, to promote active participation in scientific discussions with world-class experts. In addition, a

broad range of specialized courses are also covered at the host, e.g., in the framework of the International doctoral programme in Medical Physics and Engineering at UEF.

Annual Seminar of BioMEP will typically last 1-2 days and will serve as scientific mini-conferences to discuss research results and to deal with administrative matters relating to the doctoral programme. The annual seminar will provide a platform for the ESRs to present the progress of their work, to practice their organizational and communicational skills and as well for social networking. Also more general scientific sessions will be held at each annual seminar, which will contain lectures from invited high-profile scientists and industry leaders in order to provide breadth to the training programme. The courses will be arranged in different sites, which further give good possibilities for the ESRs to familiarize themselves with research in different universities and countries, and also with other ESRs. The final annual seminar will be special in that it will be organized as a conference open to the large public in order to broaden the dissemination of results from the programme and highlight its achievements.

Initial training day: Newly recruited ESRs will be introduced to the doctoral programme's objectives and partners within this first networking day. They will be given the opportunity to meet their principal supervisor and co-supervisor, discuss their Career Development Plan and their research project proposal.

Internet-based training: E-learning through the EVICAB platform (www.evicab.eu) has been previously implemented for the former doctoral programme and will be used also in BioMEP. Selected courses are video recorded and included in the EVICAB platform, enabling in addition to internet also mobile connections to study material. This is an exceptionally effective way to permanent and global exploitation and rapid dissemination of the courses, not only for a limited number of attendants in a classroom. Also electronic feedback procedure has been implemented, which ensures continuous quality assessment of the educational courses.

An annual International Summer School dedicated to BME and MP will be organized in order to exploit its interdisciplinary aspect and for dissemination of knowledge. Basic and advanced concepts, theoretical and experimental methods, new emerging techniques in BME and MP will be covered reflecting the multidisciplinarity of BioMEP research activities. Each research team will have the opportunity to lecture on their specific research. The summer school will extend during 3-5 days with about 6 hours of lectures per day plus poster sessions and informal discussions between participants. The summer school will act as a forum for discussing scientific questions relevant for the project, but also will offer opportunities to ESRs and their supervisors for active networking. The summer schools will be open to external students and will be integrated into the European Credit Transfer System.

Support and/or additional training in non-research oriented transferable skills;
BioMEP will organize courses for ESRs in complementary and transferable skills such as: Entrepreneurship, Research ethics, and Intellectual property rights, Grant writing, Project management, Commercial exploitation of results and Job applications and career development in academia, science and business. The

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 713645.

aim is to prepare ESRs for their future employment. This complementary training will be covered by lectures and workshops at the annual seminars supplemented by the local doctoral training programmes (e.g. University of Eastern Finland Graduate School). Complementary training at the annual seminar will be given by specialists from the academic and private sector partners (supervisors, research and business group leaders from the industrial partners (e.g. General Electric Healthcare, Planmeca, Elekta, Bindex), human-resources representatives).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 713645.

6 Rights and responsibilities of the doctoral students

Main obligations

- Work exclusively on the research training activities under the action.
  This also means that a researcher can NOT hold two MSCA grants at the same time or engage in another professional activity or employment.
- Not receive (for activities carried out in the frame of the action) other incomes than those received from their beneficiary
- Inform their beneficiary as soon as possible of any events or circumstances likely to affect the GA (such as, significant changes to their career development plan or personal circumstances affecting the foreseen activities)
- Comply with the arrangements related to the intellectual property rights
- Maintain confidentiality
- Ensure the visibility of EU funding
- Researchers must acknowledge funding under the MSCA in publications, communications or patent applications.
- Complete and submit — at the end of the training — the evaluation questionnaire and — two years later — follow-up questionnaire provided by the Agency.
- More details: Information package for Marie Skłodowska-Curie fellows: http://ec.europa.eu/assets/eac/msca/documents/documentation/publications/msca-fellows-information-package_en.pdf

Career Development Plan

ESRs will draft a personal Career Development Plan at the start of the doctoral project and will update it at the end of each year. The Career Development Plan will contain the following:

- research project proposal,
- scientific objectives,
- schedule of envisaged courses,
- secondments
- long-term career planning.

Annual reports

Each ESR will provide research reports and supporting materials as requested by the doctoral programme in a timely matter. At the end of each year the ESRs will submit a short written annual report (please find the template from BioMEP website) and arrange a thesis committee meeting. In particular, the ESR will need to maintain annual records of the following documents:

- list of all research publications
- all poster and oral presentations
- record of attendance at courses
- list of national and international activities: workshops and courses, research visits and conferences
- all patents and copyrights

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 713645.

7 Dissemination

The dissemination within the programme will be done on a daily basis via the BioMEP website. It will serve for the internal communication and information exchange between the partners. BioMEP website will also be used for outreach purposes, advertisements of vacancies, initiating press releases, announcement of project events as well as relevant conferences, summer schools and workshops. Research findings will be disseminated via poster and oral presentations at international and national conferences and annual seminar presentations. All ESRs will publish at least one first author paper per year in international high impact factor journals. All publications will be made open access either through journal's open access route or through Europe Pubmed after an embargo period given by each journal. The material produced within the project will be used for educational purposes in courses arranged in all hosting partners, thus, the material is openly accessible for ESRs. Further, 15 PhD theses will be based on this project and are open access. Research findings might either be exploited by the hosting partners or via a commercialization partner; patent protection would be sought where appropriate.

Dissemination of the results and publicity

Any dissemination of results, communication activity related to the project (1) and any infrastructure, equipment and major results (2) must:

- display the EU emblem
- include the following statement:

(1)"This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No [number]".

(2)"This [infrastructure][equipment][insert type of result] is part of a project that has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. [number]".