HCEMM TEAMING NATIONAL LABORATORY

TRANSLATIONAL MEDICINE

The main activity of the HCEMM Teaming National Laboratory is research into the causes, diagnosis, treatment, and prevention of ageing-related diseases. Its objective is to establish a centre with a strong focus on translational medicine for healthy ageing, promoting the clinical application of basic research results and to ensure scientific excellence based on an international peer review system. HCEMM trains highly qualified researchers and carries out cutting-edge research in molecular medicine focusing on the major chronic and infectious disease complexes, which affect Hungarians.

MAIN RESEARCH AREAS

- Translational medicine
- Healthy ageing
- Immuno-inflammatory diseases
- Metabolic and cardiovascular diseases
- Genomic instability and cancers
- Infectious diseases focusing on comorbidities
- Communicable diseases
- Scientific computing, Bioinformatics and Medical Informatics
- Biobanking and Phase I Clinical Trials

IMPLEMENTER:
HCEMM Nonprofit Kft.

PROJECT NUMBER: 2022-2.1.1-NL-2022-00005

FUNDING PERIOD: 01.11.2022 - 31.10.2026

OVERALL BUDGET: 1.953 934.000 HUF

NATIONAL RESEARCH, DEVELOPMENT AND INNOVATION OFFICE
HUNGARY
PROGRAM FINANCED FROM THE NRDI FUND

BENEFITS TO BE EXPECTED FROM LABORATORY RESEARCH

- Novel molecular diagnostic tools for the early detection of ageing-related diseases.
- Lower healthcare costs and increasing life expectancy and quality of life for patients.
- Commercialize and exploit intellectual property created by HCEMM research groups.
- Position Hungary on the map of international life sciences research.
- Strengthen Hungarian knowledge regions in Hungary and Central and Eastern Europe. Involve members of society in research on age-related diseases.
- Strengthen the link between academia and industry.
- Develop strong links to international organizations, with EMBL as the first example.

THE PROFESSIONAL TEAM

The current research topics at HCEMM are related to healthy ageing, with special focus on Immuno-Inflammatory Diseases, Metabolic- and Cardiovascular Diseases, Genomic Instability and Cancer, as well as Infectious Diseases, which compound the aforementioned non-infectious chronic diseases. These disease complexes affect the majority of the Hungarian population in old age, with over 75% of the mortality being caused by cancers or cardiac diseases alone.
At the moment, HCEMM includes four Advanced Core Facilities (three at the host institutions and one at the HCEMM Headquarters), 20 double affiliated Research Groups, 5 core Research Groups and 3 clinical trials and biobanking groups. Our achievements comprise of more than 300 articles in scientific journals (~71% Q1, ~32% D1), 4 chapters in books and 28 theses, which were published by researchers with HCEMM affiliation thus far, where all articles are available in Open Access. HCEMM has already concluded 13 research service contracts, under which the Research Groups and the ACF have provided specialized service for industrial and academic partners.

HCEMM currently has established the following groups:

HCEMM-USZ Skin Research Group
The Research Group has expertise in skin biology, focusing on skin immunology and translational medicine.

HCEMM-USZ Molecular Gastroenterology Research Group
The Research Group capitalizes on the advantages of patient-derived pancreatic organoid cultures and works on improving the culture system by establishing disease- relevant co-cultures of stromal and epithelial cells. These co-cultures will be used to study disease mechanisms, intercellular communication and therapeutic possibilities in inflammatory and malignant pancreatic diseases.

HCEMM-USZ Magnetotherapeutics Research Group
The Research Group is developing biophysical technologies based on electrical, ultrasonic and magnetic modalities. These are planned to be serving as high-precision non- pharmaceutical interventions, while also improving drug delivery solutions. The group pays particular attention on the treatment of disorders of the brain.

HCEMM-USZ Cerebral Blood Flow and Metabolism Research Group
The evolution of cerebral edema is a life- threatening condition, yet the concept of the Research Group is that how brain edema develops is incomplete, and treatment options remain limited. The current project addresses two challenges: (i) The development of a new strategy for timely, accurate diagnosis to predict cerebral edema formation; and (ii) to offer novel, targeted, non- invasive and personalized therapy for the effective alleviation of brain edema formation.

HCEMM-USZ Fungal Pathogens Research Group
In their HCEMM project (entitled as ‘The link between fungal colonization and cancer progression’), the Research Group aims to reveal mechanisms activated during fungi-driven oral cancer (oral squamous cell carcinoma) progression in vitro and in vivo. The group’s main research interest involves the exploration of the oral mycobiome’s role in health and disease.

HCEMM-USZ Translational Colorectal Research Group (Clinical Trials and Biobanking Group)
Crohn's disease and ulcerative colitis demand lifelong management. New biomarkers are sought for IBD due to limitations of current ones. The Group's hypothesis proposes analyzing cytokines, chemokines, and microbiome/mycobiome to identify therapeutic targets and predict treatment response, enabling personalized therapy. The research aims to determine profiles and compositions, correlating them with clinical parameters to discover predictive markers. Data and samples will be stored in the IBD biobank at the University of Szeged for analysis, aiming to uncover biomarkers for personalized treatment.

HCEMM-BRC Mutagenesis and Carcinogenesis Research Group
The Research Group is currently carrying out research on UBZ-domain-containing proteins to identify Ub-PCNA-interacting (Ubiquitination of Proliferating cell nuclear antigen) proteins and the key enzymatic activities affected by the interaction. The research will shed light on the regulatory aspects and downstream mechanisms of Ub-PCNA-mediated DNA damage bypass pathways.

HCEMM-BRC Metabolic Systems Research Group
The Research Group combines systems biology and phylogenetic approaches to understand how metabolic differences impact health and how pathogenic microbes evolve. They have extensive know-how on generating and analyzing omics data, including metabolome profiles.

HCEMM-BRC Translational Microbiology Research Group
This Research Group is aiding the Development of Precision Anti-virulence Therapy in Inflammatory Bowel Disease. They test antibiotic resistance evolution at an early stage of drug development. This could have a pivotal role in the identification of promising antibiotic candidates which could remain effective longer in clinical practice. The groups aims at providing a functional metagenomic platform that can be used to investigate horizontal gene transfer-mediated resistance evolution.

HCEMM-BRC Systems Immunology Research Group
The Group dominantly uses computational approaches to answer questions in immunology. They focus on the adaptive immune recognition of pathogens, cancer and self-molecules.

HCEMM-BRC Pharmacodynamic Drug Interaction Research Group
The Group focuses on investigating drug-pathogen-microbiome interactions that may guide future efforts to design personalized antimicrobial treatment for patients with co-morbidities requiring continuous heavy non-antibiotic medications. By systematically screening drug interactions between traditional antibiotics and non-antibiotic pharmaceuticals the group is looking for novel combinations that can clear pathogen bacteria orders of magnitude more efficiently than its susceptible counterpart and maximize pathogen elimination while protecting the healthy gut-microbiota.

HCEMM-SU Extracellular Vesicles Research Group
This Research Group focuses on the development of new gene therapeutic tools. The primary goals of the project include development of novel gene therapeutic modalities and testing them both in vitro and in vivo, in genetic murine models of cardiovascular diseases.

HCEMM–SU Molecular Oncohematology Research Group
The Research Group investigates the molecular pathogenesis of various hematological malignancies with a special focus on B-cell lymphomas. The main aim is to identify (epi)genetic biomarkers associated with therapy response and resistance. The goal of this translational research is to develop clinically applicable tools using advanced genomic technologies to support the individualization of therapies and molecular monitoring of patients with B-celllymphomas.

HCEMM-SU Cardiometabolic Immunology Research Group
The group focuses on translational cardiovascular research on the interdisciplinary fields of molecular medicine-cardiology-immunology-oncology-pharmacology. During the last 3 years, they have been working on to explore the molecular mechanisms of heart failure.

HCEMM-SU Neurobiology and Neurodegeneration Research Group
The major interest of this Group is studying healthy ageing and the pathophysiology of age-related, chronic neurodegenerative disorders such as Huntington's disease, Parkinson´s disease and Alzheimer´s disease. The group is using a unique, direct neuronal reprogramming model system, which was completely absent up to date in Hungary.

HCEMM-SU Inflammatory Signaling Research Group
Under the original HCEMM proposal on „Mechanisms of Tissue Damage Induced Inflammation" this group is conducting projects and experiments with the aim of better understanding the fundamental mechanisms that drive leukocytes to wounds.

HCEMM-SU Molecular Channelopathies Research Group
The translational relevance of cystic fibrosis transmembrane conductance regulator (CFTR) research is given by the devastating inherited disease cystic fibrosis (CF), which affects ~100 000 people worldwide, and is caused by a multitude of CFTR mutations. Thus, understanding the structural and functional consequences of CF causing mutations, as well as the pharmacological sensitivities of various CFTR mutants, is urgently needed for the development of personalized medicine approaches to combat the disease.

HCEMM-SU Thrombosis and Hemostasis Research Group
The research focuses on translational medicine in the field of thrombosis and hemostasis. In their studies they use in vitro, ex vivo and in vivo methods combined with advanced microscopic technics to uncover the pathophysiology of hemostatic processes. They concentrate on the role of neutrophil extracellular traps, von Willebrand factor and the interaction thereof.

HCEMM-SU Translational Dermatology Research Group
The Group is focused on understanding the mechanism of pigmentation, melanocyte, and melanoma biology. The Group has a particular interest in identifying novel therapeutic approaches in melanoma to overcome resistance to immunotherapies by using a combination of bioinformatics, molecular biology and in vivo mouse models.

HCEMM-SU OnkoBank Research Group (Clinical Trials and Biobanking Group)
The OnkoBank will allow researchers to carry out scientific studies using transcriptomic, genomic, or proteomic data for any of the selected tumor types. A particular focus will be on documenting anti-tumor drug, radiological, and surgical treatments and continuously updating patient follow-up. All tissue samples are stored in liquid nitrogen, which ensures that there is no loss due to storage to the highest quality standards available.

Circulating Nucleic Acid Biomarker Core Group
The Group uses high-throughput DNA Sequencing and Bioinformatics to develop new PCR-based assays for the early diagnostics of chronic and infective diseases. The goal is to develop diagnostic test kits, where plasma or serum can be utilized directly in the assay.

Human neuron physiology and therapy Core Group
The Group investigates human neuron phenotypes in their function, structure and molecular profile. The study aims to identify 'specific-to-human' neuronal features which help to understand human brain function in healthy ageing and pathology, and hopefully enable development of new therapeutic interventions in future.

Genome Integrity and DNA Repair Core Group
The Group focuses on understanding the molecular background of tumorigenesis and unveiling whether this process modulates genome integrity and maintenance. Their primary interest is how DNA damage affects the ongoing physiological cellular mechanisms such as replication and transcription. As an extension of this, they address and characterize epigenetics markers that could be potentially utilized as clinical tools in cancer-related predictive diagnostics. Therefore, the project can dynamically contribute to more precise tumor detection, evaluation, and classification even in the early stage of tumor development.

Cancer Genomics and Epigenetics Core Group
The Group studies epigenetic changes during tumor evolution using next-generation sequencing techniques, integrating gene expression, microscopy and experimental data to identify potential vulnerabilities in Small Cell Lung Cancer. In addition, they will focus on non-invasive sequencing and diagnostics methods to help predict drug response of tumors and survival of patients.

Cancer Microbiome Core Group
The group develops an integrated framework that allows patient stratification, i.e. grouping of patients based on cancer risk and response to therapy. Additionally, these investigations will reveal novel human DNA damage response pathways involved in cancer progression. The ultimate goal is to develop microbiome-associated biomarkers from non-malignant patients before tumors develop, thereby transforming therapeutic strategies from reactive to predictive.

Translational Medicine Development Core Group
The Group is a special supportive group joins to other HCEMM
research groups to facilitate the translational phase of their basic research. Once, the TMDG can develop protocols for human sample collections, otherwise when a project reaches the TRL 7-8 state, the clinical evaluation of their device or diagnostic tool can be supported by the group by the provided guidance on the regulatory pathways.

Advanced Core Facilities at HCEMM
The Advanced Core Facilities (ACF) system and services of HCEMM aims at providing a research infrastructure coordination system, which assures that the infrastructure supporting the research projects of HCEMM is utilized efficiently, jointly with the owners. This includes the creation of the HCEMM core facility system and the related coordination and management activities. The ACFs are specialized laboratories, which are equipped with cutting-edge technology and state-of-the-art machines. The services offered by each ACF are each focused in particular areas of research and development (e.g. imaging or MassSpec), in support of the activities of the HCEMM Research Groups and work with industrial partners.
The ACFs are also connected to EMBL via the EU Teaming Grant, which allows HCEMM scientists to use the unique offerings of the EMBL advanced core facilities under the same conditions of EMBL employees.
HCEMM has already established four Advanced Core Facilities, three operating at the locations of the owners, while the recently launched unit is at the HCEMM Headquarters in Szeged.

In Vivo Imaging ACF
The ACF provides services in a broad range of in vivo imaging applications using an already existing infrastructure, which is continuously being expanded. For the usually needed small animal imaging studies presumably in the forefront of possible users, the ACF has an immediate access to multiple animal models (optimized at conventional and SPF animal facilities). Tumor xenografts including a variety of cell lines are also available based on user-borne cost and maintenance models.
With the complexity of the available technological platform, the ACF offers an unprecedented and highly flexible solution to image all organ systems of the given organism statically, dynamically, and functionally. Moreover, it also provides an excellent technological arsenal for applications in multiple scientific fields of e.g. pharmacology, molecular oncology, histology, inflammation research, biomarker identification and detection – in parallel with assessing physiological and pathophysiological phenomena.

Singe-cell Omics ACF
The main goal of the ACF is to provide high-sensitivity molecular analyses of limited sample amounts, including lipidomic, proteomic, genomic and transcriptomic analyses and to develop or adopt methods suitable to study a few hundred cells and below.
The ACF offers specific services, such as proteomics, lipidomics, genomics, transcriptomics, phenomics. Mass spectrometers used for proteomics and lipidomics analyses are operated in alternating 2-3 weeks intervals for the respective measurement types. Only trained personnel can operate the instruments, customers do not have direct access to the mass spectrometers. Data evaluation is usually performed by the ACF personnel, therefore raw data are typically given out solely for publication purposes.
The genomics and transcriptomics workflows are performed by the personnel of the NGS Platform of the BRC. The users provide the starting material (DNA, RNA, miRNA, ChIPped DNA, cDNA etc.), preparation of the sequencing libraries and the sequencing is performed by experts working at the NGS Platform. The resulting raw sequence reads are handed over to the users either by downloading from ftp/cloud or deposited on external hard disks.

Functional Cell Biology and Immunology ACF

The main goal of this ACF is to provide high-throughput and high-resolution imaging, cell surface and intracellular marker detection as well as the possibility for sorting cells based on their expressed protein markers for cellular and immunology studies.

The ACF offers static and dynamic imaging applications and high-performance cell sorting and marker identification applications. The major available techniques at the Functional Cell Biology and Immunology Advanced Core Facility (FCBI ACF) include conventional (wide-field, confocal) and advanced (super resolution) light microscopy, scanning electron microscopy optimized for biological samples (including array tomography and correlative light and electron microscopy), an advanced cell sorter facility and a molecular biology facility.

Scientific Computing ACF

The Scientific Computing core facility supports all of the HCEMM Research Groups in their computational, modelling, and statistical needs, for the analysis and integration of their experimental data. We develop and implement new tools for efficient data collection, generation, storage, processing, mining, analysis, and presentation to enhance the scientific output from quantitative life science research and also host state of the art bioinformatics and medical informatics software and databases.

POSSIBLE PARTNERSHIPS

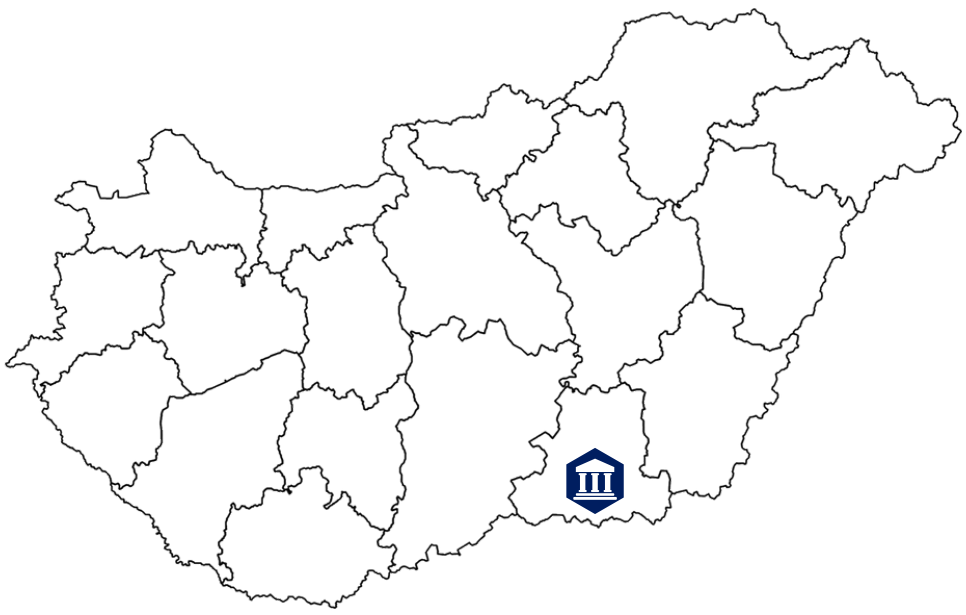
The HCEMM focuses on establishing partnerships for Joint Grants under Horizon Europe and other grant opportunities, i.e. Teaming Opportunities with European research organizations, student exchanges, scientific cooperation. The HCEMM is also looking for potential industrial partners, either for joint work and service provision, or for licensing of HCEMMs Intellectual Property.

TARGET GROUP

Target groups of the HCEMM Teaming National Laboratory are researchers from national as well as international research institutes (academic and government), the private sector, especially potential industrial partners with outreach to the general society.

PLACES OF IMPLEMENTATION:

- Szeged



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