

EXCERPT FROM  
THE DEVELOPMENT STRATEGY  
OF THE RESEARCH INSTITUTION,  
RĪGA STRADIŅŠ UNIVERSITY,  
FOR 2015 – 2020

RESEARCH PROGRAMME

## 1. Priorities and fields of the research programme

During the development of the strategy, research at RSU was structured and priorities were identified by singling out three main directions – the leading fields of research, growth fields of research and supporting fields of research.

The relevant research directions are based on the availability of resources and the potential of sustainable development, the accumulated experience, implementation of strategic management and significance of the field of research in the overall development of the University.

The priorities are selected for a medium-term.

<u>PILLARS</u>	CLINICAL MEDICINE	BIOMEDICINE	REHABILITATION	PUBLIC HEALTH
<u>BASIS OF RESEARCH</u>	MOLECULAR MEDICINE	STRUCTURAL BIOLOGY	RESEARCH METHODOLOGIES	SOCIAL/CULTURAL/ ENVIRONMENTAL/PUBLIC HEALTH
<u>THE LEADING FIELDS OF RESEARCH</u>	ONCOLOGY			
	INFECTIOUS DISEASES AND IMMUNOLOGY			
	OCCUPATIONAL DISEASES		OCCUPATIONAL AND ENVIRONMENTAL HEALTH	
	REGENERATIVE MEDICINE, TISSUE BIOENGINEERING			
<u>GROWTH FIELDS</u>	DOSAGE FORM TECHNOLOGIES (PHARMACY)			
			REHABILITATION AND PUBLIC AGEING	
			CHRONIC DISEASES UN THERAPY ALGORITHMS	
	NEUROSCIENCE/ HUMAN BRAINI DISEASES RESEARCH			
	MATERNAL AND CHILD HEALTH			
	NUCLEAR MEDICINE, RADIOLIGY AND MODERN VISUALISATION METHODS			
			SOCIAL SCIENCES	
	ANATOMY, EMBRIOLOGY, HISTOLOGY, PATHOLOGY, STRUCTURAL BIOLOGY			
<u>HORIZONTAL FIELDS</u>	ANAESTHESIOLOGY AND RESUSCITATION			
	EMERGENCY AND MILITARY MEDICINE			
			HEALTHCARE SCIENCE	
				PUBLIC HEALTH
				SOCIAL POLICY

## **1.1. The leading fields of research**

### **1.1.1. Oncology**

Oncologic diseases, including breast and colorectal cancer, are among the main causes of incapacity for employment (economic burden) and mortality. Patient survival, successful therapy and life quality depend on early diagnosis of oncologic diseases. Unfortunately, timely diagnosis in Latvia is not efficient enough: over 10% of breast cancer patients and about 24 of colorectal cancer patients are diagnosed at stage IV with bad 5-year survival prognosis. About 80% of all breast cancer cases are of sporadic form with multifactorial origin with social and economic factors playing a significant role in the development of cancer. Priorities of the field of oncology conforms with societal challenges "Health, demographic change and wellbeing" and are oriented towards personalised healthcare directions: "4. Innovative treatment methods and technologies" and "6. Integrated, sustainable and patient-oriented health care".

The main institution dealing with research in the field of oncology is RSU Institute of Oncology with 21 researchers (15.83 FTEs (full time equivalents)) in 2014, 3 of which are at the age over 70. Successful and long-lasting cooperation has been established with RSU Department of Paediatrics that has resulted in several international publications. Currently, cooperation has been developing with the Department of Biology and Microbiology and the Department of Pathology.

In 2014, several research projects were implemented, among them internal grants of Rīga Stradiņš University, research projects of national level (grants of the Latvian Council of Science, cooperation projects of the Latvian Council of Science, State Research programmes, projects funded by the structural funds within the frame of ERAF and ESF programmes). Unfortunately, RSU cannot boast of having extensive international cooperation, though it is developing step by step. For example, in 2015 RSU received funding in the amount of 357 thousand euros within the framework of the only successful Twinning project Horizon 2020 in the field of biomedicine and medicine in Latvia that will be implemented in 2016 – 2018. Planning additional funding for participation in international conferences would allow attracting new partners and preparing new international project proposals. Accordingly, regulatory enactments that regulate the transportation of DNA samples abroad that serves as a significant obstacle in cooperation with foreign partners should be aligned. Among cooperation partners are Karolinska Institute (Sweden), Pomeranian Medical University (Poland), University of Düsseldorf (Germany) a.o. institutions.

Priority research topics:

- Research of exogenous and endogenous factors associated with oncologic diseases endangering health of Latvia' inhabitants;
- Research of clinical and molecular features of malignant tumours in the improvement of early diagnostics and treatment strategy;
- Molecular and radiological characteristics of thyroid cancer for the improvement of early and justified diagnosis;
- Study of clinical and molecular peculiarities of cervical cancer for the improvement of early diagnostics and treatment strategy;
- Personalised cancer diagnostics and detection of the efficiency of treatment on the grounds of molecular profile of the tumour; development of profiling methods and –omics technologies;
- Breast cancer research: innovative diagnostic, treatment methods and methods for the improvement of patient life quality.

The following topics are set for the future:

- Molecular epidemiology of breast cancer, molecular epidemiology of hereditary tumours;
- Identification of the efficiency of clinically applicable markers in breast cancer and colorectal cancer patients;
- Proteomic analysis of metastatic cancer;
- Multimodal information platforms that integrate visual diagnostics, pathology and biomarker data, the development of cancer registers of new generation in cooperation with bioinformatics ESFRI platform ELIXIR;
- Cancer theranostics;
- PET application in diagnostics and treatment control;
- Oncogenesis research in primary cancer by applying new research technologies;
- Tumour biology: tumour heterogeneity, cancer stem cells.

These research directions are mutually related, their implementation is grounded on enormous experience of the Institute of Oncology in DNA/RNA analysis. Additionally, new research opportunities related to proteomics and stem cells will be developed and applied.

Currently, the Institute of Oncology is well equipped, funding is required for maintenance of the equipment.

#### **1.1.2. Occupational and environmental health**

The environmental impact on human health has been widely studied, however, due to rapid environmental changes (globalisation, urban development, global warming, shortage of resources, mass migration etc.), the impact of new or emerging factors on human health, including the spread of diseases caused by environmental factors and occupational diseases, needs to be increasingly predicted. Being aware of this impact and its consequences various instruments for the analysis of the spread of environmental factors and their potential impact have been actively developed to be able to carry out the required preventive measures. RSU Institute of Occupational Safety and Environmental Health and its structural units the Laboratory of Hygiene and Occupational Diseases and the Laboratory of Ergonomics are the key institutions in the field of work environment and occupational diseases. In 2014, 16 researchers (9.31 FTEs ) were employed there, solely 2 of them are of the age over 70. RSU Environmental Modelling Centre established within the institute is among the most up-to-date institutions of its kind in Latvia, however, continuous development of the centre is required to be able to ensure the required research support.

In 2014, several research projects were implemented, incl. internal grants of Rīga Stradiņš University, research project at national level (grants of the Latvian Council of Science, cooperation projects of the Latvian Council of Science, national research programmes, projects funded by the structural funds: ERAF and ESF programmes). The institute has an outstanding experience in implementing INTERREG projects. In 2015, the first EEA grant project of the Ministry of Environmental Protection and Regional Development has been commenced.

The institute has established good cooperation with other RSU structural units – the Laboratory of Biochemistry and the Laboratory of Biochemistry of the Faculty of Medicine. In future the institute sees promising cooperation opportunities with A. Kirhenšteins Institute of Microbiology and Virology, the Faculty and Laboratory of Rehabilitation, the Laboratory of Biomechanics and the Institute of Oncology. The institute is engaged in many international cooperation projects and has many partners abroad, among them Norwegian Institute of Occupational Safety, Arcada University of Applied Sciences in Finland,

Tallinn University of Technology, Lithuanian Institute of Hygiene, Finnish Institute of Occupational Health, Curie Institute in Poland a.o.

Priority research topics:

- Environmental and occupational health;
- Study of work environment conditions and their improvement – risk caused by nanoparticles, physical, microbiological, chemical and ergonomic factors;
- Early diagnosis of occupational diseases, patient rehabilitation;
- Biological ageing factors and the quality of life in Latvia's population;
- Clinical epidemiology of functional restrictions caused by health disorders in Latvia;
- Adaptogens;
- Ergonomics;
- Impact of low-dose radiation.

The following topics are set for the future:

- Study of the impact of aerosol particles and nanoparticles (chemical, biological, dust, incl. nanoparticles);
- Indoor air quality;
- Impact of external factors on ageing and work capabilities;
- Human biomonitoring;
- Ergonomics, behaviour and economics.

These studies have wide target groups, they are mainly related to researches commissioned by the government or municipality with an aim to study the impact of a single factor or a set of factors on human health by mainly focusing on so called sensitive groups, such as elderly people, pregnant women, children etc.

The planned application and commercialisation opportunities of these researches are very wide, as the study of the impact of environmental factors and mechanisms may foster the research of various diseases and understanding of their development mechanisms. It is planned to develop researches oriented towards the study of separate environmental factors by focusing on those essential for Latvia (such as air quality) and participating in extensive studies at European and at the world level and analysing the situation in Latvia.

### **1.1.3. Infectious diseases and immunology**

Researches oriented towards defining the role of infectious agents in origin and course of various human pathological processes form the grounds of the field of infectious diseases and immunology. The task of the field is to study mutual interaction between host organism and pathogens, clarify the role of viral infections in the induction of non-infectious diseases and foster the transfer of the acquired knowledge and the developed technologies to clinical and laboratory practice.

RSU A. Kirhenšteins Institute of Microbiology and Virology (AKIMV) is the main research institution in the field of infectious diseases. In 2014, 34 researchers (22.39 FTEs) were employed there, 3 of them are at the age over 70. The institute has developed successful and long-standing cooperation with other RSU structural units with an aim to reach its goals in research, including the implementation of study programmes. Among such RSU structural units are the Department of Internal Diseases, the Department of Infectology and Dermatology, the Department of Neurology and Neurosurgery, the Laboratory of Transplantology, the Joint Laboratory of Clinical Immunology and Immunogenetics, the Department of

Surgery, the Department of Paediatrics and the Joint Laboratory of Clinical Immunology and Immunogenetics. Additionally, the institute manages and implements RSU, governmental and international theoretical and practical research projects, as well as provides specialised expertise services for the government and individual clients a.o. services. Due to long-lasting studies on oncoviruses, AKIMV is the only member of International Anti-Cancer Association from Latvia. Employees of the institute are the members of various international organisations, among them the American Society for Microbiology, the International Association for Chronic Fatigue Syndrome, the European Society for Virology a.o. organisations.

AKIMV has attracted the project BALTINFECT „Unlocking Infectious Diseases Research Potential at Riga Stradiņš University” No. 316275, within the frame of the EU’s 7th Framework programme, activity *Research Potential*. It is the only REGPOT project in Latvia in the field of classical medicine. The project includes the development of human resources and infrastructure, expanding of international cooperation.

In 2014, several research projects were implemented, incl. internal grants of Riga Stradiņš University, research project at national level (grants of the Latvian Council of Science, cooperation projects of the Latvian Council of Science, national research programmes, projects funded by the structural funds: ERAF and ESF programmes). The institute has established successful cooperation with Uppsala University (Sweden), the London School of Hygiene and Tropical Medicine (UK), the Steinbeis Research Centre (Germany), the Institute of Innovative Medicine (Lithuania), the Medical University of Silesia (Poland), Karolinska Institute (Sweden), the Catholic University of Leuven (Belgium), the Buckinghamshire New University (Bucks University) (UK), the Centre of Epidemiology and Microbiology of the Ministry of Health of Byelorussia, the Institute of Experimental Morphology, Pathology and Anthropology (Bulgaria). Cooperation has been established between the Latvian Academy of Sciences (RSU A. Kirhenšteins Institute of Microbiology and Virology) and Bulgarian Academy of Sciences (the Institute of Experimental Morphology, Pathology and Anthropology) on research of the significance of viral infections in the development of autoimmune diseases. Funding in the amount of 400 thousand euros (Latvia’s share – 50 thousand euros) from COST (funded by Horizont 2020) CA15111 EUROMENE was attracted for the study of myalgic encephalomyelitis/chronical fatigue syndrome. Latvia as a project applicant has succeeded in attracting COST project for the second time in the history.

RSU Department of Public Health and Epidemiology operates in the field of epidemiology. In 2015, its researchers have received funding in the amount of 152 thousand euros for the project in the field of infectious diseases research in ERA-NET HIVERA competition. The project was ranked 2nd, and it has an outstanding coordinator – Pierre and Marie Curie University. Cooperation with top European universities in the field of HIV epidemiology has been carried out.

Priority areas of research:

- Research of latent/persistent viral infections;
- The impact of the spread of infectious diseases on public health;
- Immunomodulating therapies and immunomodulators;
- Antiviral preparations and innovative vaccines;
- Development of viral resistance, AIDS resistance in treatment schemes;
- Biotechnological methods in the production of ferments, drugs and functional food
- Immunogenetics;
- Cell immunology;
- Aberrant immune response and research of aetiological factors of inflammation;
- Study of genomes of pathogenic bacteria;
- Non-genotoxic carcinogenesis, oncoimmunology, therapeutic vaccines;

- Nanotechnologies in oncology and virology – RNA aptamers, surface plasmons;
- Laboratory animal methods in biomedical research;
- diagnostics and differential diagnostics with multiplex platforms;
- Immunovisualisation;
- Mathematical modelling of epidemics and new infections.

The following topics are set for the future:

- The detection of the involvement of beta-herpesviruses HHV-6 and HHV-7 in the development of encephalopathy, encephalitis and epilepsy by applying multidisciplinary approach;
- Study of chemokine receptors CCR1 and CCR2 as potential diagnostic markers of B-cell malignancies;
- Study of the involvement of persistent viral infections in the modulation of immune system and development of autoimmune system diseases
- Infections, autoimmune diseases and skin diseases caused by immunodeficiency;
- The relation of fibromyalgia and myalgic encephalomyelitis/chronical fatigue syndrome with the infection of beta-herpesviruses (HHV-6A, HHV-6B, HHV-7) and parvovirus B19;
- Epidemiology, pathogenicity of human bocavirus (HBoV) types and their possible association with lower respiratory tract diseases and acute gastroenteritis in children.

#### **1.1.4. Regenerative medicine, tissue bioengineering**

RSU has a long tradition in the field of regenerative medicine. In this direction RSU researchers evaluate the medical usage of ceramic biomaterials created in Latvia, which is a traditional part of sub-projects in material science within the frame of national research programme. There is a constant increase in the number of operations performed throughout the world with the use of synthetic substitutes, but due to lack of optimal substitute, there has been intensive scientific research to justify correlation of substitute properties and processes in implant during the ingrowth and functioning in live organism. The development of such substitutes is possible today on the basis of biomechanics and tissue engineering. This direction requires use of new biomaterials in creation of organs, artificial replacement of tissue, as well as with various cells. The creation of such new substitutes is associated with use of nanocoatings, nanofibres and composite biomaterials that have huge potential. But its biomechanical properties and behaviour in vivo is hardly explored. That is why the study of properties of new nanofibres and composite biomaterials and the comparison of these properties with natural tissue is topical in evaluating the possibilities of clinical use, including prevention of traumas and military injuries.

Several RSU units are operating in this field of research: RSU Faculty of Dentistry, the Faculty of Biology and Microbiology, the Institute of Anatomy and Anthropology, RSU Department of Surgery, the Laboratory of Biomechanics, the Laboratory of Transplantology and the Department of Oral and Maxillofacial Surgery. In 2014, a total of 9 researchers were employed there (4.65 FTEs), one of them above the age of 70. In 2014, research projects were implemented, incl., internal grants of Rīga Stradiņš University, scientific projects of national level and one ERA-NET project SONOSCA was completed.

RSU Faculty of Dentistry conducts researches of medical use of biomaterials created in Latvia, especially in oral and maxillofacial surgery and implantation; in cooperation with the Department of Biology and Microbiology it investigates the effects of microorganisms on biomaterials. Promising direction of research is possibilities of prevention of biofilms as destructive factor on biomaterial implants, where collaboration with furan researchers from Timber Chemistry Institute and Latvian Institute of Organic Synthesis is possible.

In research of soft biological tissue and biomechanics of different composite materials, the Laboratory of Biomechanics cooperates with RSU A. Kirhensteins Institute of Microbiology and Virology, Pauls Stradins Clinical University Hospital, Cardiology Centre of Latvia, Children's Clinical University Hospital — Clinics of Paediatric Surgery, Clinics of Paediatric Cardiology and Cardiac Surgery and RSU Department of Surgery, where doctoral students study biomechanical characteristics of different biological tissue and synthetic polymermaterials for their theses.

Laboratory of Biomechanics has a constant cooperation with Renato Arche Information Technology Centre, Department of 3D technology (Campinos, Brazil) and joint scientific research activities within the framework of Memorandum in biomechanics industrybetween RSU and RAIT. There is a large number of joint scientific publications in international journals with sufficiently high citation index.

It is essential to intensify the commercialization of biomaterials during clinical studies in this field.

Priority research areas:

- Bone replacement materials research, development of new treatment techniques. Immunohistochemical, radiological and clinical research of face and jaw deformations and pathologies, development of new treatment technologies.
- Transplants from living donors in cases of high sensitization and ABO incompatibility, organ capacity building approaches (involvement of relatives). Clinical studies of transplantology involving the clinic.
- Compatibility studies, to minimize and predict post-transplant complications, and other topical topics, e.g., in collaboration with virologists.
- Study of properties of biological tissue and new polymeric materials for their replacement.
- Structural, functional and biomechanical research-based development of disease diagnosis and treatment algorithms.
- Tissue bioengineering. Research of soft biological tissue and biomechanics of different composite materials: creation of nanofibers and composite materials.
- Medical use of ceramic biomaterials created in Latvia.

The following topics are set for the future:

- Research of personalized monitoring, diagnostics and treatment of processes caused by atherosclerosis. Work is related to the study of heart valve biomechanical properties after reconstructive operations in cases of different pathologies.
- Study of composite materials for artificial human ear auricle, main parameters of biochemical properties. It is planned to carry out the research of main parameters under tensile influence and evaluate the possible use in creation of new implants from biomechanical point of view.
- Research of biomechanical properties of nanofibre materials for different elements of cardiovascular system. It is planned to carry out the research of main parameters under tensile influence and evaluate the possible use in creation of new implants from biomechanical point of view.
- Research of innovative materials that promote the regeneration of bones.
- New generation nanocomposite materials in dentistry.



- Research of synthetic tissue substitutes and substances that promote regeneration, including applications in emergency medicine, military and sports medicine.

Researchers engaged in this field have high qualification. In the future it is desirable to increase the number of qualified personnel, however, until 2017 it is not planned to increase the funding the workload of researchers. There is also an issue with recruitment of new specialists due to low level of knowledge of graduates and due to the fact that the university does not offer education in speciality "Biomedical engineering", that could be developed in the future on basis of medical technology and biomedical programmes.

## **1.2. Growth research fields**

### **1.2.1. Dosage form technologies (pharmacy)**

In Smart specialization strategy in Latvia the availability of human resources has been acknowledged as a key obstacle in the development of innovation and research. Availability of human resources in the field of pharmacy is a major problem —at least 20 % of 3000 employees are retired or in pre-retirement age. Growth of industry will be determined by ability to overcome the shortage of human resources and gap of competences that exist in between range of competences that are available and that are necessary for development of new field. Competence problems can be solved with targeted investments in pharmaceutical and related medical technologies fields. Problems of human resources can be solved by attracting workforce with a structured migration or developing human resources of the field of pharmacy at local level.

For Riga Stradiņš University (RSU) the field of pharmacy is one of industries with international competitive opportunities. The University is able to provide the development of human resources from college-level education to higher professional education in the field of pharmacy by providing study places funded from the government budget in industrial pharmacy programme, as well as research training process. RSU together with the Association of Latvian Chemical and Pharmaceutical Industry (LAĶĪFA) must create a specialized continuing education programmes in order to train not only academically educated specialists but also to qualified certified staff according to the requirements of the industry.

Growth of the field of pharmacy in Latvia is driven by two trends related to the growth of finished medicinal products and export of pharmaceutical ingredients as well as new pharmaceutical and medical technologies. RSU specialization must be targeted at the development of research capacity of the industry not only in pharmacology, but also in pharmaceutical policy and market research, and the creation of bioequivalence and institutional capacity for scientific advice.

Growth of the industry could be stimulated by attraction of EU funds for creation of a scientific research infrastructure oriented on long-term solution of human resource competencies. Open laboratories, based on the application of comparative advantages of the University as a research organization in the absorption of structural funds, is a missed opportunity.

If the pharmaceutical industry would be based on RSU, we could create open type GMP pill and capsule technology development research laboratory with analytical capacity and pilot-type small batch plant. Such an open laboratory would serve not only for public benefit, but also as a training facility for students in finished drug technology and industrial pharmacy, as well as satisfy the requirements of industry qualification. The laboratory would also carry out commercial tasks by implementing technological pilot orders for companies engaged in the field of pharmacy.

Integration of the university with the field of pharmacy would be strengthened by clinical research centre of phase 1 and 2, the necessity whereof was highlighted by the pharmaceutical industry in smart specialization discussions. Until now, such a high value-added researches are not carried out in Latvia. The centre would provide opportunities for implementing commercial clinical researches and the development of human competence in science and research. The centre must be linked to the appropriate patient flow, choosing the venue not far from medical institutions (e.g., East Clinical University Hospital or P. Stradins Hospital). Contribution by structural funds to the centre would provide Latvian pharmaceutical companies with an opportunity to carry out studies required within the commercialization (translation) process, thereby increasing the turnover and the industry revenue. Contributions from EU funds to research infrastructure are solutions of innovative character with a long-term return for the benefit to Latvia's economy.

The pharmaceutical industry has clearly expressed its views on the necessary research and innovation infrastructure:

- Appropriately equipped laboratory with pilot batch production circuit is required for the research of solid dosage forms;
- Early phase clinical research centre.

Accordingly, promising research areas for the future:

- Research of innovative dosage forms;
- Translational medicine: from preclinical research to early phase clinical trials.

Research of biomaterials is related to the research of solid dosage forms in junction of material science and pharmacology. Innovative biomaterials with new properties enabling to coat the surface of these materials with bioactive molecules have been synthesized in Latvia.

### **1.2.2. Rehabilitation and ageing population, nutrition science and sports medicine**

The Faculty of Rehabilitation (RF), the Department of Rehabilitation (RD) and Rehabilitation Research Laboratory (RPL) are the main structural units of this direction. These units cooperate with other departments and once per two years issue the collection of articles of the conference "Society. Health. Welfare." that are included in the database Web of Science. Partners in Latvia - associations of rehabilitation professionals, rehabilitation centres and medical institutions (NRC Vaivari, RECUH, BKUS), separate patient organizations, Riga Technical University, BIOR, and other partners outside Latvia - Göteborg University (Sweden), University of Lund (Sweden), Ivanovo State Medical Academy (Russia). Doctoral theses on evaluation of values that influence and characterise human physiology and sports activities are developed at the Department of Human Physiology and Biochemistry, as well as it is planned to further expand these researches by adding with genetic studies.

Priority research topics:

- Evaluation of functioning restriction - disability, development of assessment methodology, quality of rehabilitation process and final outcome - for individuals with a wide spectrum of functional disorders and at different age groups, creation of RF database for evaluation results of functioning;
- New functional assessment technology possibilities in rehabilitation - Digital gait analysis, 3D body and environmental scanning and CAD/CAM process in orthotics - prosthetics, a number of project applications together with RTU departments have been prepared;
- IT technology in ensuring autonomous functioning and active and healthy ageing process;
- Assessment of contextual factors (environmental and personal factors) and the role of reducing the functional limitations - (launched in direction of project *Innovage*);
- Nutrition science as important healthy lifestyle study field, therapeutic food is an important healing factor;
- Research of lifestyle as a health factor;
- Role of genetic factors in nutritional choices that become important not only due to rare genetic pathology, but also in connection with certain food intolerances;
  - RSU also carries out separate studies in sports medicine, and it can be integrated into the activities carried out by the Latvian Academy of Sport Education by developing support research in sports physiology and didactics;

- Association of genetic variants with body composition and adaptation to different sports;
- RSU has implemented projects in ophthalmology. Eye diseases of an ageing population is an important field in developing new medical technologies;
- Dental prosthetics is an important research direction with high commercial potential.

### **1.2.3. Maternal and child health**

Priority research topics:

- Study of factors causing mortality and disability in children;
- Research of new diagnostic biomarkers with clinical approbation in paediatrics and paediatric surgery;
- Paediatric therapeutic biomarkers;
- Reproductive technologies and outcome prediction;
- Monogenic hereditary pathology research;
- Rare genetic disease research;
- Children with special needs in health care;
- Children's health research of perinatal and neonatal age;
- Development of cleft causing including genetic factors, diagnostic and therapeutic techniques.

Researches related to the health of children are included in the National Research Programme since the beginnings of the programme and they are expected to continue. Reproductive technologies are linked to project 2014/0048 /2DP/2.1.1.1.0/14/APIA/VIAA/074. Managing departments: the Department of Paediatrics, the Department of Paediatric Surgery, the Scientific Laboratory of Molecular Genetics, the Faculty of Dentistry, the Department of Human Physiology and Biochemistry, the Laboratory of Andrology.

Funding in the amount of 297 thousand euros was attracted within this direction for the period 2016-2020 year within the framework of Horizon 2020 programme in collaboration with Imperial College (London) in the project PERFORM.

### **1.2.4. Neuroscience and the human brain disease research**

RSU applied for the competition COST CA 15111 EUROMENE - the European ME/CFS Network, and in 2015, RSU's application was accepted, the estimated funding amounts in 400.000 euros for 4 years, which is to be spent for the development of the entire network and the beginning of research projects. Applications submitted by the new member states have been supported extremely rarely, so this area is seen as an outstanding for RSU.

The field of neuroinfections is relatively large interdisciplinary field. AKIMV has implemented large-scale projects in this field (see. the corresponding section). Neurooncology can be mentioned as another significant field, projects implemented in this field - 13/0047/1DP/1.1.1.2.0/13/APIA/VIAA/017 "Predicate test for assessment of treatment efficiency in cancer patients" and 2013/0004/1DP/1.1.1.2.0/13/APIA/VIAA/020 "Development of neuroendocrine and endocrine tumour differential diagnostics technologies".

Funding for brain diseases research was awarded for the first time within the National research programmes in 2014-2015.

Priority research topics:

- Study of health problems caused by major mental illness and cognitive dysfunction and the reduction of burden;
- Study of long-term care solutions for mental disease patients;
- Prevalence and treatment of depressive and anxiety disorders in patients with different levels of cardiovascular risk (SCORE) in primary care in Latvia;
- To contribute to depressive and anxiety disorders diagnosis and treatment and the improvement of family doctors' practices in patients with different levels of cardiovascular risk (SCORE) in primary care in Latvia, in order to promote public health improvement and reduce burden created by mental and cardiovascular diseases;
- Prevalence and impact of usage habits on depressive and anxiety disorders in smokers and alcohol users in primary care in Latvia;
- Describe prevalence of depression and anxiety disorders and the impact of these disorders to smoking and alcohol use habits in primary care, to develop effective management measures to reduce these health risk disorders;
- Neurorehabilitation and brain plasticity, adaptogens and memory enhancers, including military applications and extreme conditions in medicine;
- Traumatic brain and spinal cord injuries and neurorehabilitation after injury;
- Inflammation of nervous system, neuroimmunology and neuroautoimmune diseases;
- Biology and nursing research of neurodegenerative diseases;
- Psychosomatic medicine, post-traumatic stress disorder and other highly debilitating psychosomatic nosological units;
- Chronic fatigue syndrome, myalgic encephalopathy, fibromyalgia and other neuropathological diseases of unspecified aetiology.

#### **1.2.5. Chronic diseases, treatment algorithms, new treatments**

Translational medical section which focuses on fairly late phase research in main disease groups. One of the results of the research is clinical guidelines. Priority topics:

1. Research on major diseases aetiology, pathogenesis, diagnostics and treatment;
2. Research on rare diseases according to the International Rare Disease Consortium IRDiRC priorities;
3. Development of innovative register of chronic disease groups according to the ESFRI BBMRI platform, and ELIXIR EATRIS recommendations in support of the outcomes-based health care research (Outcome Research) and integrated care research.

Prospective topics:

- Role of oxidative stress and discoagulation in development of acute respiratory distress syndrome;
- Research of repeated cerebral infarction risk factors and antiplatelet resistance;
- Research of personalized monitoring, diagnostics and treatment of processes caused by atherosclerosis.

- Molecular mechanisms of diabetes and cardiovascular complications, pharmacogenetics and new medicinal products;
- Monitoring, automatic monitoring of the efficiency of treatment of chronic diseases;
- Development of new dermatocosmetics product for patients with metabolic syndrome for renewal of skin barrier function;
- Submitted project for Horizon 2020: *"ICT based personalized services supporting elderly with cardiovascular diseases and stroke with focus of a better integrated care model"*;
- One of the priorities of biopharmaceutical and organic chemistry cluster is individualized diagnostic and therapeutic strategy development, which is also one of RSU research fields;
- Innovative therapies in chronic diseases, biological therapy in non-oncology diseases;
- Development of monogenic diseases diagnostic algorithm, determination of genotype/phenotype correlation;
- Research of dental treatment and oral health;
- Genetic characterization of cardiomyopathies, genotype/phenotype correlation.

#### **1.2.6. Nuclear medicine, radiology and advanced visualization techniques**

Based on the involvement of RSU in operations of SIA Riga Nuclear Medical Centre, RSU in collaboration with the Centre and its other members, it is expected to develop the field of nuclear medicine, by approbating the technological capabilities of newly acquired equipment and launching a whole new research direction at the University. The infrastructure of centre allows for technologically complex projects in close collaboration with oncology directions.

Priority and prospective topics:

- PET technology in the diagnosis of tumours and experimental science;
- Theranostics;
- PET diagnostics of non-oncological disease.

#### **1.2.7. Social sciences**

RSU supports research in all directions of social sciences, which have adequate capacity at the University, and all such researches are priority to strengthen the position of social sciences at the University. The direction has a great untapped potential, especially in close collaboration with the leading research and development sectors, providing a critical assessment and alternative views, to make a significant contribution in addressing societal challenges. Synergy with health sciences is focused on public health promotion. Social innovations related to healthy lifestyle, family health, active and healthy ageing is a significant field of synergy supported by a

##### **1.2.7.1. Social anthropology**

Prospective research topics:

- Assessment of medical building habitability. The study is planned within RSU-RTU cooperation grants with participation of social anthropologists and rehabilitation professionals from RSU and architects from RTU. The study aims to develop practicable guidelines, which allow designers and architects to plan the health structures that are consistent with not only the technical requirements of hygiene, but also create social comfort and improve the usability, while contributing to the recovery process. The study is in the preparation process;

- Research of informal political and economic processes and structures in context of unstable and/or frequently changing political and social conditions, institutions and structures in the Europe and the world. For research in this area several project applications have been prepared, one of which has already won the Horizon 2020 funding and will be launched in 2016. The sponsored research focus is on the Western Balkan countries outside the European Union, but the research direction is to comparatively explore the impact of instability on social processes in different societies. Also co-operation projects oriented on interaction of citizens and the state, as well as different structures and social, symbolic and ideological flow in societies with frequently changing political environment are planned;
- Assessment of social factors of public health. In collaboration with public health, social work and rehabilitation specialists comprehensive social studies (including both quantitative and qualitative methods, including innovative in Latvia long participating observation) are scheduled in order to identify the social determinants of public health in the most dangerous domains such as chronic psychosocial disorders (different addictions, depression, autonomic dystonia, etc.), cardiovascular diseases (in particularly endangered male environment), neurological disorders (particularly for children), and malignant tumours. It is intended to shed light on both the successful prevention and treatment, and adherence, as well as rehabilitation conditions for patients - both adults and children. The study is in the planning stage; one of the areas which have already established research group in collaboration with the Ombudsman's Office and the association "Apeirons" an evaluation of the efficiency of quality and accessibility of rehabilitation in Latvia;
- Social media research with the aim of establishing automated problematic region and cyber threat, as well as the terrorist threat detection tools. The study, together with communication and IT professionals from various EU countries, is submitted for competition.

#### **1.2.7.2. Humanities**

RSU conducts research in the following priority sub-fields:

- Medical philosophy, medical ethics and deontology
- Bioethics
- Research ethics
- Medical history
- Medical terminology
- Literary studies on the reflections of human health, lifestyle and medical achievements

#### **1.3. Horizontal fields of research**

Horizontal fields of research are an important element in development of the grounds of scientific activity. Although there is a tendency to characterize them as supportive sciences, they have their own internal epistemological structure and their synchronous development is a prerequisite for the development of advanced technology industries.

Some of the topics are oriented towards satisfying the needs of end user, however practical connection with the consumer gives these structures the invaluable practical experience, that often results in publications with high citation index and allows the university to position its competences in the topics mentioned above.

##### **1.3.1. Anatomy, embryology, histology, pathology, structural biology**

RSU Institute of Anatomy and Anthropology is a research unit with the longest history, which can carry out comparative studies between different subpopulations today, as well perform a historical comparison of anthropological indicators.

It is expected for AAI to continue providing the spectrum of priority research spectrum, adding prospective directions:

- Modern microscopy methods in studies of normal and abnormal human and other mammalian cell structures (low-voltage electron microscopy, crio-microscopy, two-photon microscopy);
- Study of early stages of the development of tissues and cells and the detection of their status in population of Latvia or Europe;
- Development of new training technologies in morphology;
- Research of anatomical structures in synergy with development of sports medicine;
- Visualization of interaction of biomaterials and tissue;
- Development of innovative histology methods.

Research of structural biology has the potential in research of subcellular structures and research of xenobiotic proteins, carried out by AKIVM. RSU is not planning to create an infrastructure in structural biology, but upon necessity The research will be carried out in collaboration with the ESFRI INSRUCT platform, as Latvia has decided to contribute to this platform.

The department of Pathology has implemented several studies in collaboration with the institute of Oncology, Department of Surgery and other departments and is regularly involved in applications for the ERA-NET and other international projects. It is intended to support the research related to hybridization methods for high level studies. The aim is to create a pathology laboratory that complies with standard "*advanced pathology laboratory*", according to the standards of ESFRI platform EATRIS (broadcasting centres).

### **1.3.2. Anaesthesiology and resuscitation, emergency conditions and military medicine**

Within the frame of internal grants, several studies have been implemented in anaesthesiology and resuscitation at RSU. In this sector there is a constant flow of new doctoral theses. Military Medical Department existed at RSU until 2008, when due to the crisis it was eliminated. The sector has a high potential for commercialization, but also a global lobby, which prevents the development of new *spin-off* or *start-up* type companies. In the past, it held a successful cooperation with NATO programs for biomaterial tissue substitute, but with the creation of the European Defence Agency, the small research centres practically have no chance of breaking through to those projects. Undeniably, accidents, disasters, mass poisoning and other civil protection risk potential consequences to human health is very significant for Latvia and research in this direction is needed.

Prospective directions:

- Predictive techniques in strategy choices in anaesthesia, resuscitation and intensive therapy;
- Organ and tissue replacement applications in intensive care, the military and civil emergency medicine;
- Research of maxillofacial and dental traumas;
- Application of exoskeleton and human-machine interface for functioning in extreme conditions.



### **1.3.3. Health care**

Nursing, health psychology, health pedagogy are the industries which in recent years have greatly increased their research activity and have made projects for outline programmes. It intended to promote the development of cooperation with other priorities.

Research priorities:

- Modelling of doctor-patient interaction, promoting compliance in the care process;
- Monitoring the modern patient, introduction of mobile sensores, integrated health care technologies and approaches in the healthcare;
- Bioinformatics methods and development platform based on the ESFRI platforms ELIXIR, EATRIS and BBMRI;
- Health psychology research;
- New materials and technologies in the tertiary care (adaptive viscoelastic materials, automated hospital management);
- E-health.

### **1.3.4. Public health**

RSU is a major public health training and research institution in Latvia. Population-based monitoring, analysis and intervention methods have more significant impact due to urbanization, while social topography changes. Public health researches on factors that influence habits, nutrition, housing and professional health form an indispensable grounds for modern social policy.

Prospective directions:

- Analysis of the determinants of health in the population and stratified groups;
- Forecasting of health indicators characterizing long-term population and subpopulation;
- Healthy lifestyle factor analysis and development of recommendations;
- Biomarker methods in biomedicine and medicine;
- Preventive medicine and health promotion;
- Health care indicators and interventions studied in confined populations;
- Role of family medicine in population health care;
- Research of screening and methods of express diagnostics;
- The massive movement of persons, the impact on health care;
- Analysis of main morbidity trends and development of intervention recommendations;
- Planning of human resources in health care, on the basis of public health indicators.

### **1.3.5. Social policy, health economics, management, training technologies in health-related fields**

Crisis period from 2008 to 2010 clearly demonstrated that the health and social policy are subject to very considerable risks. Financing in health sector in post-crisis period has not been restored to the same proportion of GDP as it was in pre-crisis period.

The health care sector provides new opportunities upon improving its competitiveness. The development of health services accounted for a substantial section of the high-value-added investment projects in a final stage. According to so called "Juncker investment plan", in case of Latvia, 40% of the investment value is directly or indirectly related to the health sector.

Prospective directions:

- The health sector's internal and external competitiveness research;
- Health care facilities management, optimization, networking, quality systems;
- Analysis of return on investment in the health sector;
- Research of health as an important factor of social inclusion, healthy lifestyles as a social group status indicator and diseases as catalyst for social exclusion;
- Simulators, artificial organ models for medical training technologies;
- Research of optimal governance principles in health industry companies, start-up, spin-off.