University of Split

School of Medicine

Science Strategic Plan

2021. - 2027.

AUTHORS

Members and associates of the Research Committee::

Professor Željko Dujić
Professor Ozren Polašek
Professor Mirna Saraga-Babić
Professor Zoran Đogaš
Professor Mladen Boban
Professor Eduard Vrdoljak
Ana Utrobičić, PhD
Lana Barać, PhD
Professor Katarina Vukojević

Content

1. Introduction

The School of Medicine in Split (USSM) was founded as an independent faculty within the University of Split on March 26, 1997 as the first new faculty in the democratic and independent Republic of Croatia. Since its establishment, the USSM has developed by expanding its staff, facilities, equipment, and teaching and scientific activities, with the primary task of educating young professionals who, with their knowledge, skills, and attitudes, would become the bearers of the medical profession and science at the regional and national level. In addition to the Medicine program in Croatian, there are another three integrated undergraduate and graduate study programs: Dental Medicine, Medicine in English, and Pharmacy (in cooperation with the Faculty of Chemistry and Technology of the University of Split). The Medicine and Dental Medicine study programs last 6 years and are accredited with 360 ECTS credits, while the Pharmacy program lasts 5 years and is accredited with 300 ECTS credits. The USSM also has a Doctoral School with three post-graduate doctoral study programs: Evidence-Based Medicine, Biology of Neoplasms, and Translational Research in Biomedicine. In addition, the USSM has four specialist study programs: Pediatrics, Anesthesiology, Reanimation and Intensive Care Medicine, Ophthalmology and Optometry, and Sleep Medicine. The curricula are based on all key Bologna recommendations.

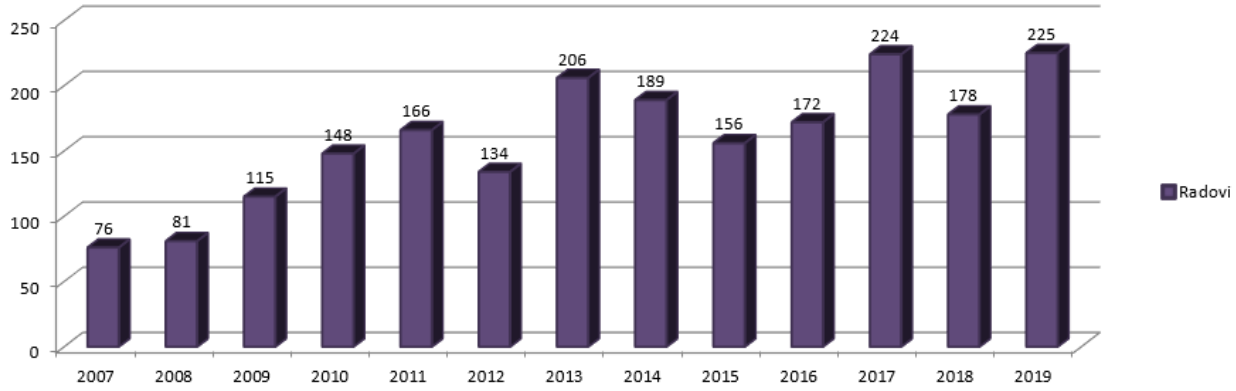
The Medicine program enrols 90 students annually, the Dental Medicine and Pharmacy programs enrol 30 students, while Medicine in English enrols 60. The educational results so far are reflected in the completed education of multiple generations of Doctors of Medicine, many of whom continued their successful scientific or medical careers in Croatia and abroad.

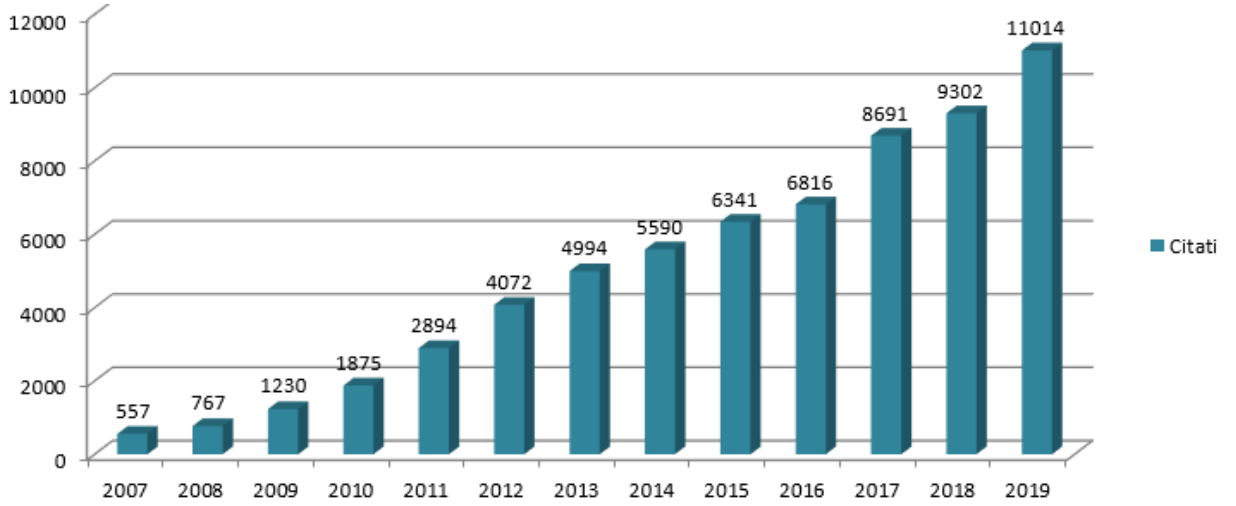
The USSM is the headquarters of the electronic edition of the international Croatian Medical Journal. Furthermore, the Croatian Center for Global Health operates at the School, whose main activity is the creation of new ideas translated into scientific projects, with the aim of discovering new knowledge applicable to the improvement of people's health globally. In addition, the Center for Sleep Medicine and Cochrane Croatia (the only center of the Cochrane Collaboration in Southeastern Europe) is located at the School.

The School is located in Križine, in the immediate vicinity of University hospital of Split, and consists of three buildings where teaching, research, and administrative activities are carried out. It also includes accommodation facilities for visiting teachers, a restaurant and the School of Medicine club Pub@Med. The School has several teaching units, the main being the University Hospital of Split, found in two locations in the immediate vicinity (Firule and Križine), but also general hospitals in Dubrovnik, Šibenik, Zadar, Pula, as well as county institutions: the Health Care Center, the Teaching Institute for Public Health, the Dental Polyclinic and Pharmacies of the Split and Dalmatia County.

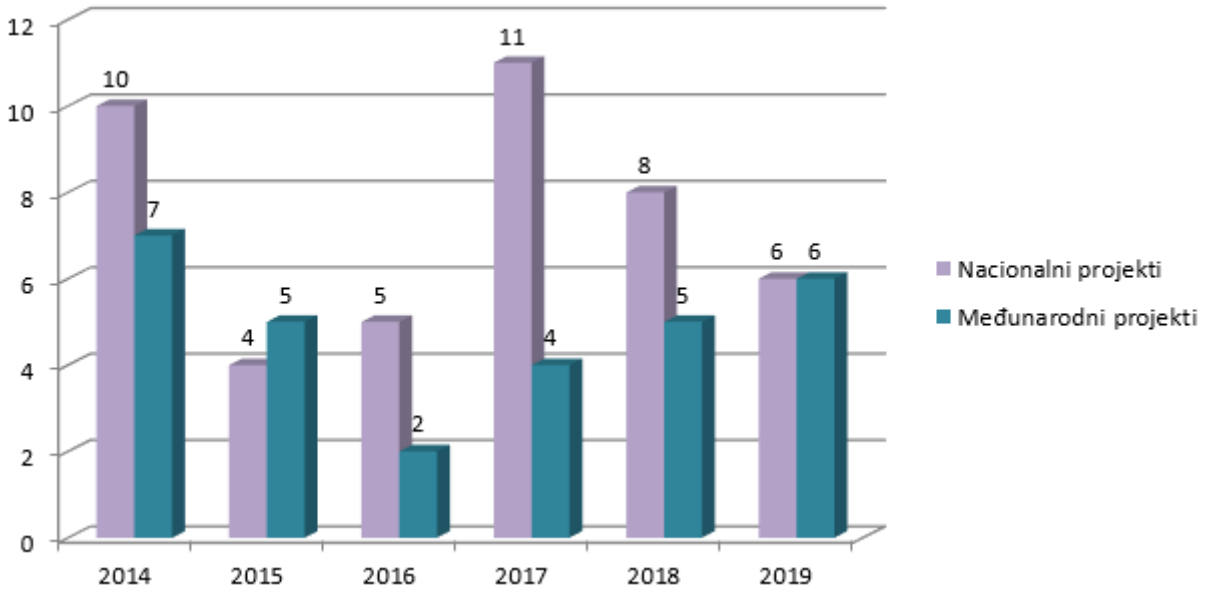
The School of Medicine is one of the most scientifically productive faculties at the University of Split thanks to:

- high advancement and promotion criteria that encourage research activity,
- strong promotion of scientific work at the School,
- training of a significant number of teachers at international institutions.





The Research Office provides administrative support for scientific research activities at the School.



The data refer to newly contracted projects.

Mission

The mission of the University of Split School of Medicine (USSM) is to educate capable healthcare workers who will improve medical profession, education and science with their professional work and knowledge. The student is at the center of the teaching and scientific process and their role is to apply knowledge from basic and clinical medical sciences, and public health through responsible work in the profession, scientific research and innovations.

The scientific mission of the USSM is based on translational research in biomedicine through connecting the fields of basic, clinical and public health sciences. The School wishes to preserve good academic values and practices through respect for fellow scientists from biomedicine and healthcare and to encourage scientists skilled in obtaining national and international projects that result in the advancement of science, through application in the scientific process and improvement of medical activity.

Vision

The School of Medicine in Split is internationally recognized for its excellent results in education and research in the field of biomedicine and health. Its vision is to improve transnational cooperation, exchange and networking, and encourage excellence with the aim of strengthening the setting for research and innovation, creating high-quality new knowledge, strengthening human capital in the field of research and innovation and encouraging the spread of knowledge and open science.

2. Analysis of the current state and USSM's positioning in research and business setting

2.1. Alignment of the USSM's science strategic plan with relevant national and international strategies

In the past several years there have been changes to the legislative framework in the Republic of Croatia, many strategic documents relevant to the field of research, development and innovation have been adopted, and, as part of the National Reform Program, many measures are being implemented that contribute to the idea of the European Research Area. The science strategy of the School of Medicine in Split is planned respecting the objectives of the Smart Specialization Strategy of the Republic of Croatia for the period from 2016 to 2020, the umbrella document of the innovation policy in the Republic of Croatia which includes relevant aspects of various national strategies, and in accordance with the development plan of the new Smart Specialization Strategy for the period from 2021 to 2029. The priority goal of the Science Strategic Plan of the USSM is to steer research in thematic and sub-thematic priority areas in the direction of translational research, the aim of which is to integrate findings originating from basic, clinical or population research into clinical application in order to improve human health and healthcare, but also to improve the transfer of knowledge in the opposite direction, from clinical practice to research. In accordance with the National Strategy (NS 2030), the USSM Science Strategic Plan aims to especially focus on direction 3 - Competitive, enterprising and innovative Croatia, which encourages the development of a competitive and technologically advanced economy based on knowledge and innovation as well as the stimulation of scientific excellence, creativity and commercialization of research and development activities, branding, digitization and the application of new technologies, the development of smart skills that could contribute to strengthening the ties between the scientific community and the business sector. It will also focus on directions 7 and 8, which, among other things, encourage training and lifelong education, as well as the smart specialization of regions and the direction of integrated territorial investments aimed at strengthening the position in global value chains.

In accordance with the development measures of the Strategic Plan of the Ministry of Science and Education of the Republic of Croatia for 2020-22, the goals of this Strategy will enable structured and focused development towards an internationally competitive scientific system and continuous alignment with the international framework of science and technology, i.e. equal participation in international initiatives in the field of science and technology, as well as more successful inclusion in the new multi-year Framework Program of the European Union for research and innovations Horizon Europe. Special emphasis will be placed on activities aimed at strengthening and increasing the efficiency of existing infrastructural and human scientific potential, but also on establishing new ones, with the aim of increasing the international competitiveness of the USSM. In alignment with the measures from the Education, Science and Technology Strategy, modern information and communication infrastructure is one of the prerequisites for the functioning of the science and higher education system. At the same time, such an infrastructure should be specifically developed with the aim of efficient collection and processing of information, as well as ensuring permanent and reliable storage and open access to scientific and

professional information generated by means of public funding. By encouraging the strengthening of priority scientific research areas, the foundations will be created for strengthening the efficiency of existing infrastructure potentials, which will be continuously directed towards greater excellence, international significance and more rational use. Therefore, by strengthening human resources and encouraging international and cross-sectoral mobility and cooperation, it is imperative to ensure a sufficient number of highly qualified experts and continuously invest in their education and training, and at the same time strengthen the system for the quality absorption of these experts. Development measures in the next strategic period will be directed towards research activities with the aim of integrating findings originating from basic, clinical or population research into clinical application in order to improve human health and healthcare. The research development strategy will be guided by the directions and priorities of the new Cohesion Policy framework in the period 2021-2027 and in accordance with the proposal for the new multi-year financial framework 2021-2027 (MFF) introduced by the European Commission at the EU27 level. In accordance with the new EU program for research and innovation for the period 2021 - 2027 Horizon Europe, the USSM plans to encourage transnational cooperation, exchange and networking and excellence with the aim of strengthening the setting for research and innovation, creating high-quality new knowledge, strengthening human capital in the field of research and innovation and encouraging the dissemination of knowledge and open science. In particular, open science will be supported by ensuring open access to scientific publications and research data and responsible management of research data in accordance with FAIR principles. Initiatives to join the Health cluster will be encouraged through intervention areas: lifelong health, non-communicable and rare diseases, tools, technologies and digital solutions in the field of healthcare, including personalized medicine, environmental and social determinants affecting health, infectious diseases, including poverty-related and neglected diseases and health systems.

2.2. Compliance with the Strategy of the University of Split

The School of Medicine in Split actively participated in the creation of the university strategy, and the School strategy is aligned with it. The strategy of research work, technology transfer and innovation of the University of Split is based on a stimulating scientific research environment, development of international cooperation and networking, encouragement of scientific research excellence, conducting international evaluations and ranking of the University.

In conclusion, the Research Development Strategy of the School of Medicine in Split is fully in line with and follows the basic principles of Croatian and European strategic documents.

2.3. Scientific productivity

The core of the USSM's scientific potential lies in its researchers. The School of Medicine, according to the latest report by the Ministry of Health, has 94.4 full-time equivalent (FTE) persons employed in research and development. Of the total number, 16 FTEs are technical staff/laboratorians and 20 are assistants/PhD students working on projects. The FTE of persons elected to the scientific-teaching position is 57.4.

The USSM is a one of the smaller medical schools in Croatia and the region, but it is one of the best Croatian scientific institutions in terms of scientific achievements, demonstrated in the number and quality of published papers. The USSM strives to establish a system that will build up research potential and encourage cooperation, especially in the application of interdisciplinary projects and programs with new lines of research, all with the aim of strengthening its competitiveness and international recognition.

Research work at the USSM is significantly above the Croatian average, and relatively close to the lower European threshold. The most productive research groups were created in the field of applied physiology, genomics, embryology, neurophysiology, pharmacology and oncology.

In the period from 2014 to 2020, scientists from the School of Medicine in Split published 1,414 papers indexed in the Web of Science Core Collection (WoSCC). These works have so far collected 22,514 citations and their h-index is 61. When analyzing the data, all represented indexes and all papers, except those indexed as editorial, meeting abstract or correction, were taken into account. The search was carried out at the end of November 2020 (Figure 1).

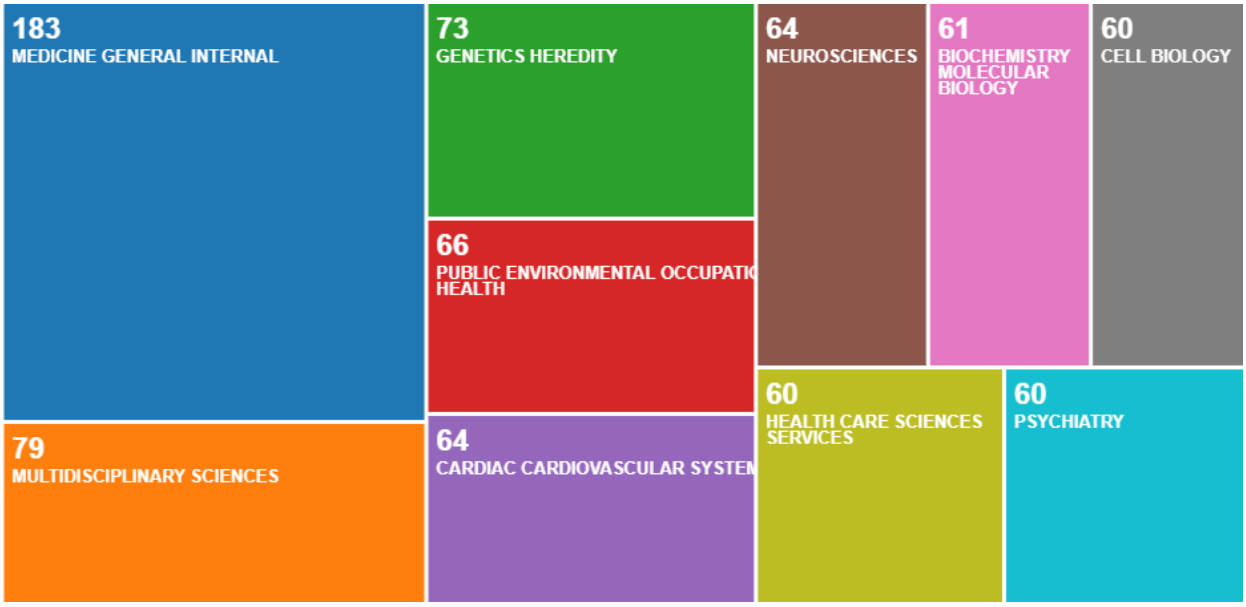


Figure 1. The first ten categories of journals in which the largest number of papers were published in the period from 2014 to 2020.

The largest number of papers, total of 183, was published in journals classified in the Medicine, General & Internal category. This category contains 165 journals whose median impact factor according to data from the Journal Citation Reports database for 2019 is 1,681, while the aggregate impact factor (for the entire category) is 4,391.

Medicine, General & Internal covers journals in areas such as: general medicine, internal medicine, clinical physiology, pain management and military medicine.

The next category of journals with 79 published papers is Multidisciplinary Sciences. It contains 71 journals whose median impact factor is 1.866, and the aggregate impact factor for the entire category is 5.327.

The category Multidisciplinary Sciences includes different science fields, such as physics, chemistry, mathematics, biology, etc. Journals such as Nature and Science belong to this category.

Genetics & Heredity is the third category of journals with 73 published papers. It comprises 178 journals with a median impact factor of 2.830 and an aggregate impact factor of 4.091.

This category includes sources dealing with the structure, function and properties of genes and the inheritance characteristics.

There were 66 articles published in the Public, Environmental & Occupational Health category. The category contains 193 magazines with a median impact factor of 2.104 and an aggregate impact factor of 2.915.

Public, Environmental & Occupational Health covers the areas of epidemiology, hygiene and health, parasitic diseases and parasitology, tropical medicine, industrial medicine, occupational medicine, infection control and preventive medicine (Table 1).

Table 1. The first ten categories of journals in which the largest number of papers was published in the period from 2014 to 2020, listed based on the aggregated impact factor.

Categories Data Filtered by: Selected Categories: 'BIOCHEMISTRY & MOLECULAR BIOLOGY','CARDIAC & CARDIOVASCULAR SYSTEMS','CELL BIOLOGY','GENETICS & HEREDITY','HEALTH CARE SCIENCES & SERVICES','MEDICINE, GENERAL & INTERNAL','MULTIDISCIPLINARY SCIENCES','NEUROSCIENCES','PSYCHIATRY','PUBLIC, ENVIRONMENTAL & OCCUPATIONAL HEALTH' Selected JCR Year: 2019 Selected Editions: SCIE

Rank	*Category*	*Edition*	*# Journals*	*Total Cites*	*Median Impact Factor*	*Aggregate Impact Factor*
1.	CELL BIOLOGY	SCIE	195	2,359,746	3.683	6.278
2.	MULTIDISCIPLINARY SCIENCES	SCIE	71	3,816,232	1.866	5.327
3.	BIOCHEMISTRY & MOLECULAR BIOLOGY	SCIE	297	3,962,918	3.167	4.696
4.	MEDICINE, GENERAL & INTERNAL	SCIE	165	1,651,656	1.681	4.391
5.	CARDIAC & CARDIOVASCULAR SYSTEMS	SCIE	138	1,051,808	2.375	4.361
6.	GENETICS & HEREDITY	SCIE	178	1,288,876	2.830	4.091
7.	NEUROSCIENCES	SCIE	272	2,548,868	3.052	4.041
8.	PSYCHIATRY	SCIE	155	925,489	2.500	3.640
9.	PUBLIC, ENVIRONMENTAL & OCCUPATIONAL HEALTH	SCIE	193	1,050,617	2.104	2.915
10.	HEALTH CARE SCIENCES & SERVICES	SCIE	102	449,411	2.161	2.703

The fifth in order is the Cardiac & Cardiovascular System category with 64 published papers. The total number of journals in this category is 138, with a median impact factor of 2.375 and an aggregate impact factor of 4.361.

Cardiac & Cardiovascular Systems covers journals in the field of diagnostics, treatment and prevention of heart diseases. Sources that focus on circulation, hypertension, arterial disease and stroke are placed in the Peripheral Vascular Disease category.

Among the remaining five categories, the Cell Biology category has the highest aggregate impact factor as well as the median impact factor.

In the period from 1997 (the year in which the School became autonomous) to 2020, 3,070 papers were published and indexed in WoSCC. They collected 81,469 citations and had an h-index of 118. The first ten categories with the largest number of papers are almost completely identical to those published in the period from 2014 to 2020, but in different order. The difference is in the Anthropology category, which is listed second in this period, while in the period from 2014 to 2020 the category Psychiatry was listed instead at the bottom of the ranking list.

In this period (1997 to 2020) the largest number of papers by our researchers was also published in journals classified in the Medicine, General & Internal category (Figure 2).

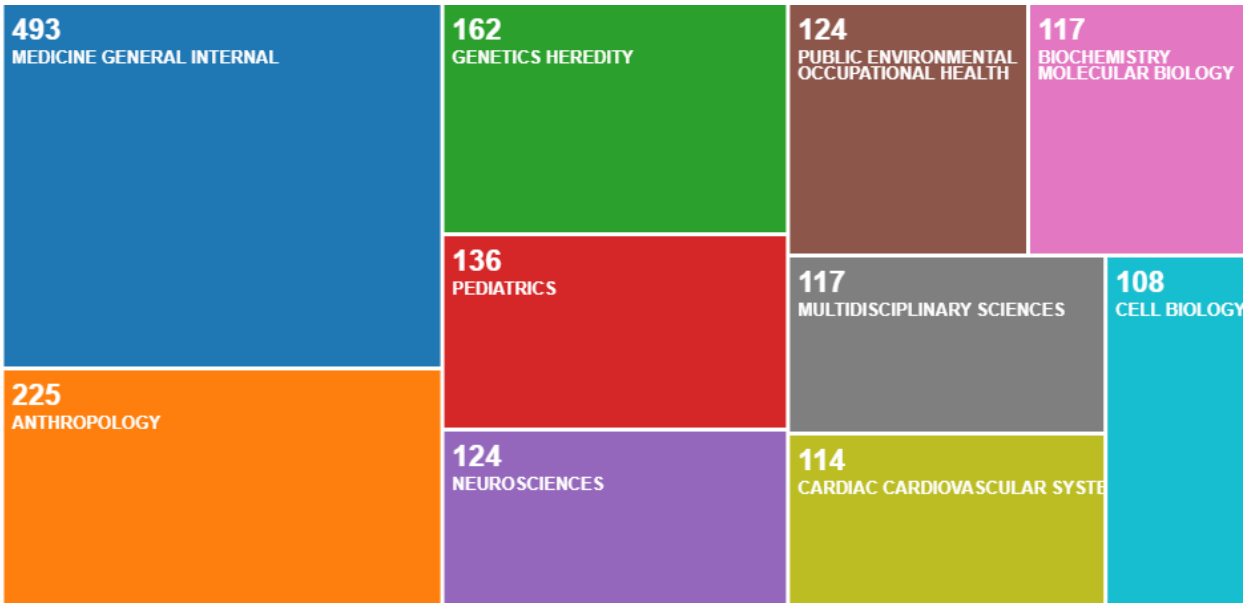


Figure 2. The first ten categories of journals in which the largest number of papers was published in the period from 1997 to 2020.

3. Strategic goals of research development at the USSM

The strategic goal of scientific research development at the USSM is to create an effective and stimulating research environment modeled on developed countries of the European Union. Stimulating research setting in which every scientist has the freedom in their work and has access to scientific infrastructure will contribute to successful integration into the science system and the values of the European Union, which will in turn stimulate the development of society based on the research findings.

Strategic goals of scientific research development at the USSM for the minimum period of six years

No.	Goal	Measures to attain the goal	Implementation at the School level
		PLANNING AND PROFESSIONAL DEVELOPMENT OF RESEARCH STAFF, ORGANIZATION OF SUPPORTING ACTIVITIES, AND THEIR ROLE	
1.	To profile and strengthen research groups	➢ increase employment of excellent young researchers (IMPACT project) ➢ Influence the refinement of legal acts that will improve scientific personnel policy (MD, PhD programs, full-time doctoral students) at the level of the University and the Ministry ➢ employ productive researchers who will bring new research projects and increase citations ➢ motivate young researchers to stay in the Republic of Croatia by improving working conditions and strengthening the international reputation of the USSM ➢ provide scholarships for young researchers in the best national and global research institutions, and provide employment opportunities after their return ➢ develop cooperation with Croatian researchers abroad and with international top leaders in their fields ➢ develop a system of research work with students ➢ encourage the establishment of student associations that will include students motivated for research	▪ School management ▪ Doctoral School Council ▪ Research Committee ▪ Office for Research, Postdoctoral Studies and Continuing Medical Education ▪ Association “Science” ▪ Student associations ▪ researchers

- design activities for education in terms of improving the generic skills of young researchers who will be competitive on the labor market and contribute to the implementation of scientific excellence in biomedicine ("Everything a student needs!" package, a laboratory practice course for employees, associates and students)
- achieve prerequisites for financing small institutional projects for doctoral students and postdoctoral students

- build new and improve the existing infrastructure for research, development and innovation

- encourage researchers to apply for scholarships and mobility to other research institutions

- provide support to researchers in applying for national and international projects at all levels of funding (one-stop-shop)

- computerize project management procedures (digital transformation)

- provide support to scientific centers of excellence

- 16. provide specific support for basic scientific research

	STRENGTHENING THE IMPACT OF SCIENCE ON SOCIETY THROUGH TRANSLATIONAL RESEARCH IN BIOMEDICINE		
2.	To encourage cooperation between preclinical, clinical and public health groups at the School and teaching units by conducting translational research	➢ educate employees, associates and students at all levels of medical training on the application of translational research and its importance for the development of society ➢ strengthen cooperation with the real economy in terms of achieving results that can be applied in the development of new medical products and services ➢ develop cooperation between the School and teaching units in the field of knowledge transfer ➢ connect the School's and clinical capacities of the teaching units in the application for national and international projects in the field of translational research ➢ develop the application of translational research for the benefit of society as a whole.	▪ Committee for Continuing Medical Education ▪ School Management ▪ Doctoral School Council ▪ Study program council ▪ Research Committee ▪ Office for Research, Postdoctoral Studies and Continuing Medical Education ▪ researchers
	COLLABORATION WITH OTHER RESEARCH INSTITUTIONS		
3.	To create synergies in the interdisciplinary fields of science, biomedicine, technology and innovation	➢ develop the role of the USSM within the University of Split on the strategic development of science and collaboration with other faculties ➢ encourage academic collaboration with other research institutions with the aim of networking with the best domestic, European and global research institutions	▪ School management ▪ Researchers

4.	To encourage continuous monitoring and analysis of public health indicators and their application in health policies	➢ develop new ideas and projects with the aim of discovering new knowledge applicable to the improvement of human health on a global level ➢ strengthen excellence in the research of genetic, environmental and social determinants of the health of the human population at the global level ➢ encourage effective synthetization of new and existing information and transfer and dissemination of this information to the public.	▪ Croatian Centre for Global Health – CCGH ▪ Cochrane Croatia ▪ Office for Research, Postdoctoral Studies and Continuing Medical Education ▪ School Management

4. Expected outcomes of the Science Strategic Plan 2021-2027

1. Through its Departments, Laboratories and Centers, the USSM will act as a regional biomedical center that will provide the researchers from the field of basic, public health and clinical sciences with the access to research facilities. Research activities will be focused in the field of translational biomedical research with the aim of connecting researchers from basic, public health and clinical fields to enable a more efficient transfer of results from research laboratories to the patient and vice versa.

2. The patient is at the center of interest of all research activities. By connecting teams for translational research in biomedicine, the USSM will become the main center of academic collaboration for all individuals who put the health of the population and the well-being of the patient first. A stimulating scientific setting will result in the exchange of ideas and the transfer of knowledge towards the real economy and society as a whole, and will contribute to the stronger development and progress of biomedicine. By participating in the Erasmus+ PROMISE project, we will develop the principles of predictive, preventive, personalized and participatory medicine, which represent the main basis of the modern approach to the treatment and prevention of disease. Patients and patient associations will be partners in research, but also beneficiaries of research results through the application of new drugs and/or devices. Accordingly, the ultimate goal will not be another scientific publication of results, but the ultimate goal will be the well-being of the patient.

3. The student is at the center of the research and teaching process. The USSM will actively and systematically involve students of medicine, dental medicine and pharmacy in the research work of existing and newly formed research groups. This approach is relevant for biomedicine and society as a whole, because it prepares students for high quality research and clinical work. These students will become excellent physician researchers, and their patients will receive the best medical care. On the other hand, students will offer new solutions with their creative thinking and commitment, which they will implement in cooperation with top researchers and mentors.

4. The Research Medical Center Split (RMCS) project, as the backbone of the research work of University Hospital of Split and University of Split School of Medicine, enables the grouping of researchers and equipment in one place, which will add value for the USSM and society as a whole. RMCS will be located in a new building in Križine, and will be physically connected with a closed glass footbridge to the USSM. In this way, new laboratories and equipment will be available to researchers, which, together with the newly renovated animal facility, will provide the conditions to conduct top research projects. Doctoral students and postdoctoral students, together with their mentors, will have space and equipment to carry out research activities in cooperation with clinics and departments of our teaching units, as well as with the industry and companies. The improvement of personnel and facilities will enable the further development of the careers of young researchers who will become future leaders of research groups, laboratories, and projects making breakthroughs in biomedicine.

5. Lines of scientific research

The basic foundation of USSM's scientific research is translational research in biomedicine, which is represented by research projects submitted to national and international calls, and includes six main lines:

1. Human genetics

- Regulation of receptor-mediated mitophagy in cells of the erythroid lineage. Project leader: Associate Professor Ivana Novak Nakir
- The role of microbiota in the development of bladder tumors. Project manager: Professor Janoš Terzić
- The role of the Spartan protein in DNA replication - SprtnRep. Project leader: Professor Ivana Marinović Terzić
- Regulation of thyroid and parathyroid gland function and calcium homeostasis in the blood. Project leader: Professor Tatiana Zemunik
- Protein carbonylation in aging, health and disease (CarboNyx) Project manager: Professor Ozren Polašek
- Genome-wide association analysis of Hashimoto thyroiditis (HashimotoGWAS). Project leader: Professor Vesna Boraska Perica
- Identification of new genetic loci implicated in regulation of thyroid and parathyroid function (THYPARATHYFUNCTION). Project leader: Professor Tatiana Zemunik
- Pleitropy, gene networks and gene pathways in isolated human populations: the 10,001 Dalmatians biobank (PNP). Project leader: Professor Ozren Polasek
- The role of autophagy receptors in selective removal of mitochondria (AutoMito). Project leader: Associate Professor Ivana Novak Nakir

2. Cardiovascular diseases

- Normative models of vascular biomarkers for improving cardiovascular risk stratification in primary and secondary prevention. Project leader: Associate Professor Ana Jerončić
- Studying Reperfusion Injury in Human Heart; How to Combat Negative Aspects of a Life-saving Therapy (REFINE). Project leader: Professor Marko Ljubković
- The role of myocardial bioenergetics in the therapy of ischemic heart disease: a translational approach from the patient to the mitochondria (CardioTranslate). Project leader: Professor Jasna Marinović
- Investigating Pathological Processes in Ischemic Human Myocardium; Basic Science Tools for Major Health Problems (ISTHMUS). Project leader: Professor Darija Baković Kramarić
- Biological effects of wine: the influence of vinification technology, dealcoholization and aging of wine (BioWine). Project leader: Professor Mladen Boban
- Cerebrovascular regulation during apnea in elite scuba divers (CEREBROFLOW). Project leader: Professor Željko Dujić

3. Medical Ethics

- Professionalism in healthcare: decision-making in practice and science (ProDem). Project leader: Professor Ana Marušić
- Professionalism in healthcare (ProHealth). Project leader: Professor Ana Marušić
- Mapping the Ethics and Research Integrity Normative Framework (EnTIRE). Partner on the H2020 project: Professor Ana Marušić
- Virtue based ethics and Integrity of Research: Train-the-Trainer program for Upholding the principles and practices of the European Code of Conduct for Research Integrity (VIRT2UE). Partner on the H2020 project: Professor Ana Marušić
- Standard Operating Procedures for Research Integrity (SOPs4RI). Partner on the H2020 project: Professor Ana Marušić

4. Neuroscience, sleep medicine and neurodegeneratie diseases

- Revolution of sleep diagnostics and personalized health care based on digital diagnostics and therapeutics with health data integration (Sleep revolution 965417). Partner on H2020 project: Professor Zoran Đogaš
- Changes in the respiratory and sympathetic nerve activity during acute intermittent hypoxia (Intermittent_hypoxia). Project leader: Professor Maja Valić
- Treating neuropathic pain with dorsal root ganglion stimulation (NeurMod). Project leader: Professor Damir Sapunar
- Translational research on neuroplasticity of breathing and effect of intermittent hypoxia in anesthesia and sleep (TIHO2_SLEEP_BREATH). Project leader: Professor Zoran Đogaš

5. Diseases of the urogenital system

- The role of inflammation in the development of malignant bladder tumor (iBC). Project leader: Professor Janoš Terzić
- Characterization of candidate genes for congenital anomalies of the kidney and urotract during development in mice and humans (CAKUT). Project leader: Professor Katarina Vukojević
- Immunomodulatory effects of mast cells and eosinophils in the microenvironment of bladder tumors - emBC. Project leader: Associate Professor Jelena Korać Prlić

6. Biophysics

- Discovering the organization and function of the cholesterol domain in the plasma membrane of fibrous cells of the eye lens using fluorescent methods. Project leader: Associate Professor Marija Raguž

In addition to the mentioned topics, the USSM also has a large number of publications in other areas and topics (Chapter: Analysis of the current state) that are not funded from national and international projects but through institutional fees and incentives for excellence: lifestyle medicine; neoplasm biology; human embryo; mental health; anthropology; inflammatory bowel diseases; regenerative medicine and rehabilitation; autoimmune diseases, bioinformatics and data analysis.

Research topics that the USSM intends to investigate:

- Basic, clinical and translational research

  - Sleep and sleep disorders with special emphasis on breathing disorders during sleep and the effects of hypoxia (and hypercapnia).
  - Neurophysiology and neuropharmacology of breathing with special emphasis on animal models with acute intermittent and chronic hypoxia (and hypercapnia).
  - Neuroanatomical and neurophysiological mechanisms of various systems using transcranial magnetic stimulation (TMS).
  - Physiological and pharmacological research on the cardiovascular system at the level of in vitro and in vivo animal studies and interventional studies on humans.
  - Effect of heart "preconditioning" by consuming moderate amounts of wine for cardioprotective effect.
  - Effect of diving (SCUBA and breath holding) on cardiovascular, cerebrovascular and respiratory function.
  - Pathophysiological changes in the bioenergetics and electrophysiology of the heart muscle in the most common heart pathologies.
  - Therapeutic and preventive options of targeted interventions in metabolic pathways.
  - The role of reactive oxygen compounds in the aging processes of heart and skeletal muscle, and in the processes of reperfusion injury.
  - Regulation of receptor-mediated mitophagy in cells of the erythroid lineage.
  - Investigating the role of Spartan protein in DNA replication and repair of DNA/protein covalent bonds (DPC).
  - Pathogenesis of bladder tumors.
  - Immunomodulatory effects of mast cells and eosinophils in the microenvironment of bladder tumors.
  - Development and diseases of the urogenital system with a special emphasis on the characterization of candidate genes for congenital anomalies of the kidney and urotract (CAKUT) during development in mice and humans.
  - Microvascular complications of diabetes mellitus, with special emphasis on molecular mechanisms of angiopathy development in diabetes and tumors
  - Modulation of calcium channels in diabetic nephropathy and neuropathy.
  - Molecular microbiology.
  - Research in the field of head and neck development, and the pathogenesis of autoimmune diseases (scleroderma, lichen sclerosis, etc.).

- Influence of neuromodulation potential of different waveforms and frequencies on spinal ganglion cells.
- Expression of glycoantigens and changes in glycophenotypes as determinants of certain physiological and pathophysiological conditions.
- Regulation of thyroid and parathyroid gland function.
- Understanding the genetic and environmental determinants of Hashimoto's thyroiditis.
- Aging and diseases related to aging.

- Public Health research

  - Cardiovascular disease risk stratification using biomarkers of arterial elasticity in a large population-based study.
  - Genetic epidemiology of isolated populations.
  - Primary research on decision-making in science and practice.
  - Evidence-based medicine.
  - Research integrity.
  - Breastfeeding medicine.
  - Mental status of students in Split and Dalmatia County
  - Psychomotor growth and development of children with pervasive disorders
  - Peculiarities of traumatic memories of victims of sexual abuse in the war

- Dental Medicine research

  - Etiology of hypodontia and other hereditary orthodontic anomalies.
  - Development of innovative technology of direct 3D printing of mobile orthodontic devices.
  - Histological profiling of glycosaminoglycan expression in the gingiva of patients with generalized destructive periodontitis in humans.
  - Pathogenesis of periodontal diseases.
  - Mutagenicity and genotoxicity of dental materials.
  - Anthropological research in dental medicine with special emphasis on dental identification and dental age.
  - Modern principles of chemomechanical treatment of teeth.

- Pharmacy research

  - Research on human subjects in the field of dermatology and cosmetology (monitoring of changes in objective skin parameters and application and development of human in vivo models of skin damage).
  - Measurements of changes in antioxidant capacity ex vivo as part of clinical studies.
  - Research on the metabolism of endobiotics and xenobiotics via CYP enzymes.

6. Strategic plan for the organizational research development

6.1. Research potential

In the six-year period, the development of research potential of the USSM and its teaching units plays a strategic role. The functional integration of the School and teaching units is an important precondition for the full development of research potential, which would improve medical excellence, high level of teaching activities, excellence in research and raising the university's value. The synergy of the Hospital (University Hospital of Split and other teaching units), the School and the University administration is needed to achieve this goal, along with the chain of responsibility for research activities and ethical conduct of research.

The University Hospital Split and the University of Split School of Medicine (USSM) are two internationally recognized institutions engaged in basic and clinical research in the field of biomedical sciences. Both institutions employ top scientists with a large number of published research papers and a wide network of scientific collaborators. Our institutions educate professionals in the study programs of medicine, dental medicine and pharmacy, as well as in the study programs of nursing, radiological technology, midwifery, physiotherapy and laboratory diagnostics. Medical Studies in English study program was launched in 2011, and cooperation with the Regiomed Clinic from Coburg which became the teaching unit of the USSM began in 2017.

University Hospital of Split is the central clinical hospital institution for the southern Croatian counties where professional, teaching and research work is conducted. This institution serves a population of about 1,000,000 citizens of the Republic of Croatia and part of the population of Bosnia and Herzegovina, and that number is significantly increased by tourists. Over 50,000 patients are hospitalized in the University Hospital of Split annually, while over 600,000 patients are treated in other health care facilities which provide over 2.5 million services annually. In order to maintain and improve the acquired level of quality, it is necessary to develop research as our goal is to provide state-of-the-art health care.

The University of Split School of Medicine is among the teaching and research institutions in Croatia with the highest number of published papers cited in WoS in relation to the number of researchers. The USSM, in addition to the Medicine study program, also offers study programs of Dental Medicine, Pharmacy, and the Medicine in English. In full teaching capacity, the USSM has a total of 1,240 students, and teachers also participate in classes at the Department of Health Studies and at other faculties of the University.

In order to improve the conditions and opportunities for research, University Hospital of Split in partnership with the USSM and the University of Split started the preparation of a project to build and equip a research medical center. The construction is planned on a vacant lot owned by the University Hospital of Split, locality Križine, in the immediate vicinity of the USSM building. The location of the Research Center will enable the connection of research and clinical work, and the direct and rapid transfer of new knowledge and findings to clinical practice.

The general goal of this project is to increase the capacity for research, development and innovation that will improve the quality, scope and relevance of research activities in the field of biomedicine and healthcare and the transformation of RMCS into an internationally competitive research institution that creates new scientific, social and economic value. The implementation of the project will

have positive effects on the Croatian science, in terms of promoting knowledge, developing cooperation between the private and public research sectors, achieving international cooperation and creating a favorable environment for excellence in the field of biomedicine.

The construction and equipping of a large research and innovation infrastructure - the Research Medical Center Split (RMCS) will strengthen the research capacities of the USSM and the University Hospital of Split, thus enabling the further development of their research activities through conducting top research, developing innovative methods of preventive medicine, diagnostics and treatment and developing cooperation with the wider scientific community and the business sector. The cooperation of these two institutions will enable the connection of scientific research and clinical work and the direct and rapid transfer of new knowledge, technologies and discoveries to the clinic, which will significantly contribute to bridging the gap between the research and its application in practice. In addition to the research groups of the USSM and the University Hospital of Split, RMCS resources will be available to the wider scientific community and the business sector in the Republic of Croatia and abroad. The establishment of the RMCS will raise the level of quality, scope and relevance of research activities in the field of biomedicine and health, and enable connection to a common pan-European network of research infrastructure. With the establishment of the organizational structure of RMCS, the USSM and the University Hospital of Split will be organizationally transformed and enable researchers to apply knowledge in specific solutions, supplementing their previous research work by mutual exchange of knowledge and conducting focused, marketable and high-quality research, the combination of which leads to innovations. The research center of the USSM and the University Hospital of Split will ensure the progress of medical science with the research work of national and foreign experts. Organizationally, the center will have common facilities that will enable cooperation between researchers and laboratories. The project proposal is currently on the reserve list of research infrastructure projects of the Ministry of Science and Education for financing from the EU funds (European Fund for Regional Development).

Taking into account all the elements of the School's activity and the achieved scientific results during the past period, it is clear that the USSM with its teaching units represents an institution with great scientific potential, and that in many segments of its work it is among the most successful at the regional level.

6.2. Research focus

The research capacities of the USSM and the University of Split together with University Hospital of Split and other teaching units of the USSM (General Hospital Dubrovnik, General Hospital Zadar, General Hospital Šibenik, General Hospital Pula) have a special role in developing and raising the level of translational research in biomedicine as a basic research focus. The largest number of research topics that the USMM focuses on and intends to research are represented by research projects submitted to domestic and international calls, and by research topics. They include various areas: cardiovascular diseases; lifestyle medicine; neoplasm biology; development and kidney diseases; inflammatory bowel diseases; neuroscience, sleep medicine and neurodegenerative diseases; endocrine diseases; regenerative medicine and rehabilitation; human genetics; cell and tissue biology, biochemistry and biophysics; anthropology, bioinformatics and data analysis, and research in dental medicine and pharmacy.

7. Success indicators of science strategy implementation for a minimum six-year period

Success indicators of science strategy implementation for a minimum six year period

No.	Success indicator	Milestone	Implementation at the School level
		INDICATOR 1. DOCTORAL STUDY PROGRAMS ALIGNED WITH THE STRATEGIC PROGRAM OF SCIENTIFIC RESEARCH	
1.	Improvement of teaching, mentoring and research capacities and infrastructure	➢ scientific reputation of the study program (leaders, mentors and teachers/researchers, but also of their doctoral students who completed the program) at the local and international level ➢ at least 50% of doctoral studies are carried out by own staff ➢ teachers with as many papers as possible relevant to the area and field of study ➢ a sufficient number of mentors (ratio of the number of mentors and doctoral students is less than 1:3) ➢ formally established and developed mechanisms for checking and monitoring the qualifications of mentors and teachers based on scientific excellence ➢ work in a modern and high-quality scientific environment	▪ Doctoral School Council

2.	Improvement of the internal quality assurance system of the study program	➢ justification of the study program ➢ assessment of the scientific foundation of doctoral education and the quality of the strategic program of scientific research in accordance with the content of the program, the selection of doctoral students, mentors, etc. ➢ established mechanisms for periodic evaluation and improvement of the quality of doctoral studies (regulations, instructions, procedures, established practices, etc.) ➢ the quality of mentoring procedures using documentation that ensures the quality of mentoring ➢ academic integrity (prevention of plagiarism and other unethical behavior) and freedom of scientific research ➢ study program expenses that justify the tuition fee	▪ Quality Assurance Committee ▪ Committee for internal assessment of the quality assurance system

3.	Support for doctoral students and advancement during their studies	➢ clearly defined obligations of mentors and co-mentors, doctoral students and research groups ➢ the needs of society and the scientific community for the number of enrolled students i.e. expected number of completed PhDs (taking into account the average completion rate) ➢ the capacity of research projects and other sources of funding to support research of enrolled doctoral students and the share of project or other funding in the financing of studies ➢ enrollment of the best students with affinity for research, publication of calls at the international level (ORFEUS, etc.) (selection mechanism – e.g., candidate interview, project proposal and individual work plan for three years, etc.) ➢ transparency of candidate selection and the right to object; high standard procedure (e.g. regulated with an ordinance) for the recognition of previous achievements relevant to doctoral studies; implemented and improved institutional support measures	▪ Doctoral School Council ▪ Study Program Council ▪ School Management

4.	Improvement of programs and outcomes of doctoral study programs	➢ orientation of the study program on research and focus on the independent work of doctoral students. The teaching is conducted according to the research needs of doctoral students (flexible content) and enables the acquisition of generic (transferable) skills and international experience ➢ quality and level of written/designed course learning outcomes at level 8.2. of the Croatian Qualification Framework ➢ learning outcomes of the study program are designed so that they are logically and clearly connected to/arise from the learning outcomes of individual teaching contents, mentoring and research work (self-analysis and discussion with doctoral students (and alumni) ➢ quality of teaching methods (are teaching methods suitable for development of individual research skills, such as research, experimental and laboratory teaching methods, methodological workshops, etc.) ➢ support in developing business and management skills, presentation skills, writing and project management, seeking financing, etc.; internationalization of doctoral studies (mobility of research staff, doctoral students) ➢ the institution is familiar with the European Charter and Code for Researchers and implements the principles of the Charter	▪ Doctoral School Council ▪ Study Program Council ▪ Teaching Committee ▪ Office for research, postdoctoral studies, and continuing medical education ▪ School Management

INDICATOR 2. STRENGTHENING THE QUALITY OF RESEARCH GROUPS			
5.	Improvement of the quality of staff	➢ scientific and professional training of doctoral students, postdoctoral students and other research and professional staff, as well as training of mentors ➢ increasing the number of good researchers ➢ permanent employment of good researchers ➢ increasing the number of professionally trained mentors ➢ develop the application of translational research for the benefit of society as a whole	▪ Committee for human resources ▪ Committee for Continuing Medical Education ▪ Study Program Council
6.	Improvement of performance in basic, clinical and public research	➢ number and citations of scientific and professional publications ➢ completed scientific research and professional projects ➢ success in applied, developmental and translational scientific research ➢ created intellectual property (patents, new research tools, copyrights, technological, research and digital platforms) ➢ establishment of own companies and incubators ➢ cooperation agreements with the business sector ➢ licenses and income from profits	• School of Medicine Library • Office for research, postdoctoral studies, and Continuing medical education • School Management

7.	Improvement of equipment and organization	➢ upgrade of existing capital equipment and acquisition of new equipment ➢ 2. new research units ➢ unification and synergy of complementary units and laboratories ➢ availability of research equipment to all researchers	▪ Research Committee ▪ School Management
	INDICATOR 3. SOCIALLY USEFUL SCIENTIFIC COMMUNICATION		
8.	Improvement of scientific communication	➢ number of participations in scientific broadcasts ➢ giving professional opinion and advice ➢ organizing educational and promotional events for the public ➢ organizing workshops and communication skills courses for experts ➢ successful provision of scientific, advisory and professional services ➢ defined services in the field of basic and applied research ➢ agreements with service users ➢ making profit from the aforementioned activities	▪ Research Committee; ▪ Office for research, postdoctoral studies, and Continuing medical education • School Management