

**NATIONAL BACKGROUND REPORT ON MEDICAL RESEARCH FOR  
MONTENEGRO**

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## **Abstract:**

This report was done for the needs of EC FP7 project WBC-INKO.NET in partnership with the Ministry of Education and Science, Government of Montenegro. The report is a brief overview of medical scientific research activities in Montenegro. It includes: legal framework, scientific research institutions and an overview of research activities in the last ten years. The last chapter of the report brings a brief account of socioeconomic conditions in Montenegro and the main directions of future medical research.

# **1. Legal framework of medical research in Montenegro**

## **1.1. Overview of legal infrastructure and strategy of development**

Medical scientific research activities are not covered by a law nor by a strategy of development in the form of an enactment. This field of research is partially covered by several laws and strategies of development:

- a) The Law on scientific research activities
- b) Strategy of scientific research activities in Montenegro ( 2008-2016)
- c) The Law on health care
- d) Strategy of health care development in Montenegro

### *a) The Law on scientific research activities*

The Law on scientific research activities<sup>1</sup> regulates “scientific-research activities, organization, conditions and method of funding of the activities, as well as other issues important for carrying out scientific-research activities.”

Scientific research activities are activities of public interest. Carrying out scientific research activities is free and accessible to all, domestic and foreign, natural and legal persons. Principles of scientific research activities are: “increase of cultural and economic development of Montenegro; broadening and intensifying of scientific knowledge; helping scientific development aimed at efficiency increase, preservation and development of general knowledge; increase of efficiency of scientific research activities and connecting scientific organizations, educational organizations and industry; including into European Research Area and EU Framework Programmes for scientific research activities; freedom and autonomy of scientific creativity; providing appropriate education for eminent experts for research and development; ethics and responsibility for the consequences of their work of persons engaged in scientific-research work; sustainable development and protection and improvement of the living environment; protection of personality and dignity of persons engaged in scientific research work; international

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<sup>1</sup> Official Gazette of the Republic of Montenegro, no. 71, 28 November 2005.

quality standards; major investments in scientific research activities; connecting persons engaged in scientific research activities on state and international levels.”

Scientific research activities, according to this law, include: fundamental, applied and development research activities as well as human resources training for scientific work.

“Scientific research activities can be carried out by: the Montenegrin Academy of Sciences and Arts, the University of Montenegro, institutions of higher education, scientific-research institutions and other legal and natural persons, in accordance with the law. Activities of the Montenegrin Academy of Sciences and Arts are regulated by a separate law.”

The Law defines scientific research institutions, their establishing as a public or private institution, conditions for establishing, licensing, keeping a register of licensed institutions, managing of institution, research and scientific titles and conditions for appointment for a research or scientific title.

The Government establishes the Council for the Scientific Research Activities for facilitation of the scientific research activities. The Council analyzes the state and the achievements within scientific research activities and gives expert proposals to the Government. The Council is composed of nine members, appointed by the Government. One third of the Council members are appointed from the Government, and two thirds are appointed from the eminent experts from the scientific research area.

Institution can acquire funding from: the national budget, providing intellectual services, from income made by selling products and services, donations, sponsorship, legacies, wills, projects and contracts with domestic and foreign research institutions, and from consulting services, business associations, institutions and organizations, resources from foreign funds, and other sources.

Strategy of scientific and research activities is adopted for determining priorities of scientific research activities, as well as for fostering and monitoring them.

#### *b) Strategy of scientific and research activities in Montenegro*

Proposal of the Strategy of scientific and research activities of the Republic of Montenegro<sup>2</sup> (2008-2016) was adopted by the Council for the Scientific Research Activities on 30 May 2008. The proposal was made by the Commission of the Council composed of nine members.

Proposal of the Strategy is in accordance with the most important documents that define the directions and aims of development of Montenegro, that is: Montenegro Ecological State Development Directions, National Strategy for Sustainable Development of Montenegro and Spatial Plan of the Republic of Montenegro.

Scientific research activities are treated in the similar way in all these documents:

- development should be based on knowledge, and science should have a key role in solving future developmental challenges;
- scientific research activities should be on a higher level, primarily by means of larger funds on the part of the state.

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<sup>2</sup> Proposal of the Strategy of scientific and research activities of the Republic of Montenegro (2008-2016) (adopted by the Council for the Scientific Research Activities on 30 May 2008)

The Strategy presents an overview of the current state and stresses weak links between scientific research activities and educational and economic spheres, which results in poor effects on human resources development, technological development and export competitiveness. The current treatment of scientific activities in Montenegro is poor.

Montenegro has certain experience of creating scientific research programmes in the context of bilateral agreements with neighbouring countries and EU countries.

Active interdisciplinary international projects are funded by the German Rectors' Conference, Norwegian Council for Science, ERA-NET project within FP6, bilateral cooperation, INTERREG.

In two rounds of FP7 there have been 58 project proposals in which partners from Montenegro participated. In the first round 7 projects received funding (1-research project, 3-European network of national contacts for FP7, and 4 projects of coordination and support).

Within TEMPUS III programme 15 JEP projects, 9 SCM and 31 IMG have been realized. Student mobility has been realized through CEPUS, TEMPUS, INTERREG programmes, IAESTE, and SE-ERA-NET.

The Montenegrin Academy of Sciences and Arts has participated in the activities of ALLEA, EASA, EMAN, IACSEE, ICSU, CEEN and realized activities in joint projects as well as study visits to 22 national academies of sciences and arts.

Prioritised fields and activities in the period 2008-2010 (short term plan) are:

1. Reorganization of institutional and administrative structures
2. Development of staff resources and infrastructure
3. Informatics and library capacity
4. Technological development and information

Prioritised fields and activities in the period 2010-2016 (long term plan)

In the period 2010-2016 resources should be used for staff, infrastructure and technological development and innovations.

The state of Montenegro should start investing appropriate amount of budgetary resources in RTD (Research, Technology, Development). The amounts invested thus far are insufficient for achieving the norms of the community we aspire to.

### *c) The Law on Health Care*

The Law on Health Care<sup>3</sup> treats scientific research activities in several articles. Article 36 states that “The scientific research and scientific activity shall be organized and conducted on the tertiary health care level”; article 47: “The Clinical center shall be the teaching facility of the school of medicine and it shall perform the teaching and scientific research activity within clinical branches of medicine, in accordance with the law”; article 48: “The Special Institute shall perform also the teaching and scientific research activity, in accordance with the law”; and article 49: The Institute for Public Health

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<sup>3</sup> Official Gazette of the Republic of Montenegro, no. 39, 9 June 2004

“researches and develops activities within public health area, health policy, and creates public health programs”.

*d) Strategy of health care development in Montenegro (September 2003)*

By adopting “Health policy in the Republic of Montenegro until 2020”, Montenegro has joined a unique international process of implementing papers of the World Health Organization 'Health for all in XXI Century' and '21 objectives for the 21st Century'. The health care policy strategy established by way of this document is founded on improving the quality of health of the population, by adapting and improving activity of the health care system in harmony with financial abilities. Health policy in Montenegro until 2020 has defined general objectives of health policy: extending life expectancy, improving quality of life relating to health, decreasing differences in health and financial risk insurance.

The health care system is organised as a unique health care region and is based dominantly on the public sector. Public health care institutions are organized through a network of primary, secondary and tertiary health care consisting of eighteen medical centres, seven general hospitals, three special hospitals, the Clinical Centre of Montenegro, the Institute for Health and the Pharmaceutical Institute of Montenegro. The private sector, not yet integrated in the health care system, comprises a larger number of medical centres, dental centres, wholesale medicines and pharmacies.

The existing health care resources, within the framework of the public sector indicate that the accessibility and development of health care infrastructure, especially with regard to the number of beds and number of doctors is at the same level as more developed countries. The Strategy analyzes state of health of the population. Positive and negative indicators show the state of health of the population: birth rate, mortality, natural increase and vital index. The state of health of the Montenegrin population, measured according to health indicators, is level with countries of Eastern and Central Europe. However, values for the most frequently used health care indicators lag behind the values of Western European countries. Quality health care and services as a parameter for efficiency of the health care system has not been researched in health care institutions. The reasons for improving the system of control may be found in a lack of professional standards, non-developed information system, as well as the lack of a complete evaluation of the health care program.

The strategy of development of health care system represents the basis for consolidating other specific documents shall establish in detail, activities, bearers, priorities and criteria for evaluation plans. These documents shall enable carrying out health reforms. Health care system in Montenegro shall provide better quality health care, and improve the state of health of the population through a series of continuous activities and measures aimed at prevention, curing and rehabilitation of the diseased. The functions of public health shall have special importance in prevention of chronic non-infectious diseases, such as cardiovascular diseases, smoking and consequences of smoking, protection and promotion of health of mothers, the young and the old. By promoting staff and organizational development, conditions for professional and scientific affirmation of health institutions will be met.

Health Information System (HIS) is one of the basic components of contemporary health care system. The trend in this area is mostly founded on two strategies:

- making a network of all local information systems and creating an integral health information system, and
- development and quality improvement of information service in health care.

Modern HIS should, among other things, be able to ensure: availability of all scientific, clinical and other achievements in the field of medicine in the electronic form, as well as interconnection and compatibility with similar systems in the country and abroad.

## **1.2. Institutional framework of scientific research activities**

Scientific research activities in general, as well as in the field of medicine, are carried out in Montenegrin institutions founded in the previous decades. Medical research is carried out in: Montenegrin Academy of Sciences and Arts, University of Montenegro, School of Medicine, Institute for Public Health, Center for Science of the Clinical Center of Montenegro.

Montenegrin Academy of Science and Arts was constituted in 1973 . Today it is the supreme institution in the field of sciences and arts in Montenegro. It consists of Department of Natural Science, Department of Social Science and Department of Arts.

University of Montenegro is comprised of seventeen faculties, three scientific institutes, the University library and several specialist departments. The University of Montenegro is the only public university in the country.

Medical faculty in Podgorica began work in academic year 1997/1998. As unique educational, scientific and medical institution, organize undergraduate and postgraduate studies in domain medicine and dentistry.

Institute for Public Health is the professional and methodological, scientific and educational institution for the areas of epidemiology, hygiene, social medicine, organisation of health care and health service, health statistics and informatics.

The Center of Science of Clinical Centre of Montenegro is fully operational and conduct several patient studies and research activities.

In the non-governmental sector research institutions have been founded recently: Institute for strategic studies and prognoses (ISSP), Center for democracy studies, Institute of accounting, as well as certain number of private consultant firms. However, in the field of health care there isn't any private institution for scientific research, nor has there been any initiatives in that direction.

## 2. Overview of medical scientific research activities in Montenegro

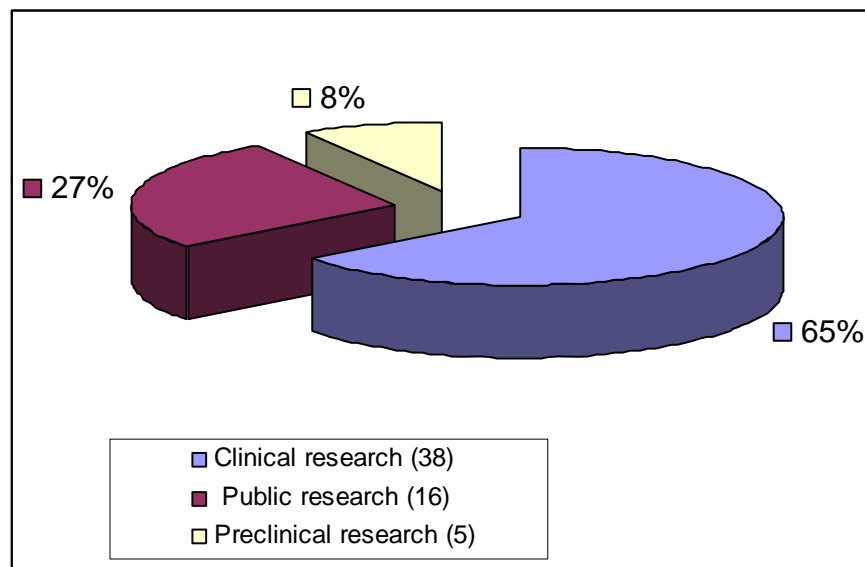
### 2.1. Scientific projects

#### 2.1.1 National medical scientific research projects in Montenegro

In the last ten years 59 research projects of public research institutions have been approved in Montenegro.

Almost two thirds of projects are clinical research (65%), public health research amounts to 27%, and preclinical research accounts for 8%, as shown on Fig. 1. The Ministry of Education and Science of Montenegro has supported their realization.

**Figure 1. Types of medical scientific research projects in Montenegro**

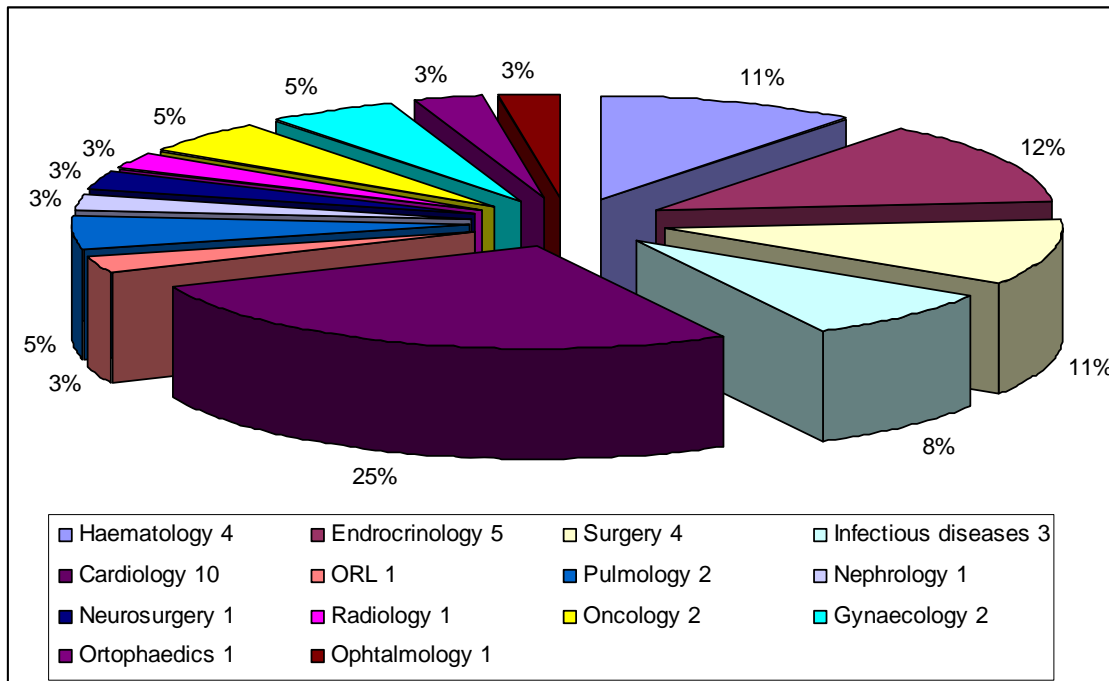


Of 38 clinical research projects 7 are experimental clinical studies of which four belong to internal medicine and three to the field of oncology.

According to fields of study the largest number of research projects belong to clinical research and its structure is shown on Fig. 2. Cardiology accounts for the majority of them (25%), and is followed by endocrinology (12%), haematology (11%), surgery (11%) and all other clinical specialties (41%).



**Figure 2. Overview of research projects in clinical specialties**



According to the purpose of the reserach there were 39 applied and 20 fundamental researches (aimed at enhancing the level of knowledge in the field of research).

There is only one research co-financed by the **Ministry of Education and Science of Montenegro** which is part of the **ERA-NET project within FP6** and which belongs to the field of public health.

### 2.1.2 Projects approved by Ethics committee of the Clinical Center of Montenegro

Out of the aforementioned projects (59 in total) 13 have been approved by Ethics Committee of the Clinical Center, of which 7 are fundamental, experimental studies of applied research type, and another 6 are descriptive studies, mostly of analytic type (all the projects belong to the field of clinical research). Two of them are partner projects. The largest number is in the field of oncology (6), followed by cardiology (2) and 5 belong to other fields.

### 2.1.3. Projects of the Montenegrin Academy of Science and Arts

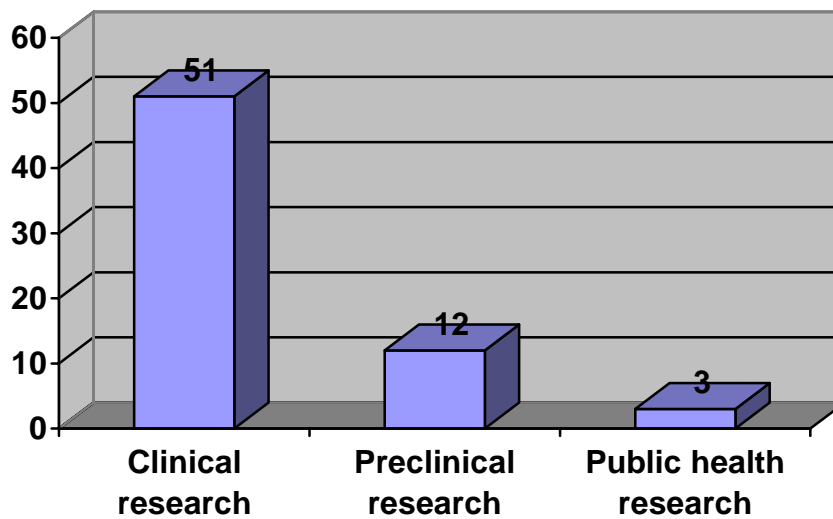
Five of the aforementioned projects are supported by the Montenegrin Academy of Science and Arts, of which four belong to the field of public health and one is a clinical research in the field of neurosurgery.

## 2.2. Other scientific research activities

### 2.2.1 Doctoral dissertation research in the field of medicine

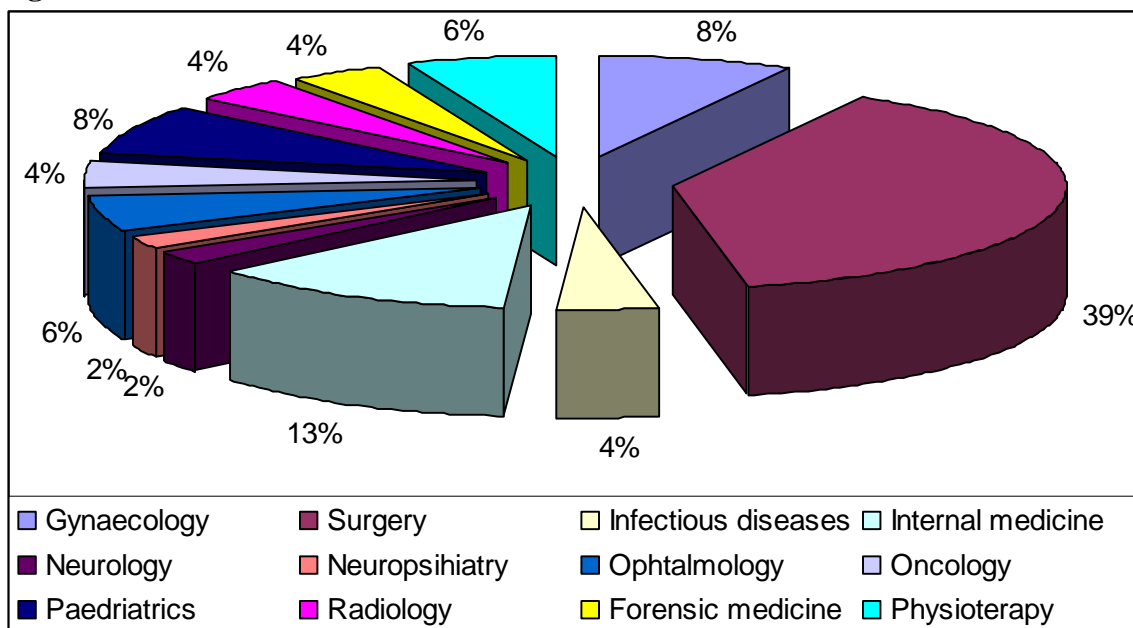
Doctoral dissertation research in the field of medicine is represented by 66 doctoral theses, whose fields of study are shown on Fig. 3.

**Figure 3. Doctoral dissertation research and fields of study**



Doctoral dissertation research mainly belongs to the field of clinical research, and every fourth (39%) is a research in one of surgical specialties (fig. 4). They are followed by the dissertations in the field of internal medicine (13%), paediatrics and gynaecology (each account for 8%), while the least number is in the field of neurology and psychiatry.

**Figure 4. Doctoral dissertations in the fields of clinical research**



In the field of surgery the majority of dissertations belongs to general surgery, and these are followed by orthopaedics and urology.

In the field of internal medicine the majority belongs to cardiology, and then endocrinology, pulmology and nephrology.

Doctoral dissertations in the field of preclinical reserach are in the fields of pathophysiology (5), occupational health (2), microbiology (2), physiology, biochemistry and anatomy (one in each of these fields).

There were also postgraduate master's theses in the fields of preclinical research (9), clinical research (48) and 2 in the field of public health.

### **3. Overview of conditions and directions of development of medical scientific research in Montenegro**

#### **3.1 Influence of socio-economic circumstances and health policy on scientific research activities**

Health policy and strategy of health care development in Montenegro have joined a unique international process of implementing papers of the World Health Organization (WHO) 'Health for all in XXI Century'. They are in accordance with the Millennium Development Goals and aim at improving the quality of health of the population, by improving activity of the health care system in harmony with financial abilities. Health care policy in the Republic of Montenegro until 2020 represents the foundation for legislative platform and action programmes, with the objective to make health care more

efficient and of better quality and to include health care system in Montenegro in the European and World health development process. Health care policy in Montenegro until 2020 has defined general objectives of health policy: extending life expectancy, improving quality of life relating to health, decreasing differences in health and financial risk insurance. Organization and financing of health care are based dominantly on the public sector, which, due to GDP and intense pressure on public expenditure, presents considerable challenges. The ongoing reform of health care system will enable an integration of private into public health sector as well as overcoming problems in health care that have been present for a long time.

Between 1956 and 2006 the population of Montenegro increased from 440,998 to 624,240 in 2006, which represents a total increase of 41.55%.

In all countries due to the ageing of population and the introduction of new and expensive medical technologies there is an ever-present increase in expenditure for providing health care service.

According to 2003 Census of population in Montenegro, there were 12.8% percent of people older than 65 in general population (of which 10.5% males and 13.4% females) and this number is constantly increasing like in all other European countries: Austria (16.7%), Croatia (17.3%), France (16.3%), Germany (18.3%),Greece (18.5%), Serbia (16.5%). Old people's needs for health care are 3.5 to 4.5 times greater than the needs of population younger than 65.

Every society going through the process of socio-economic transition faces the phenomenon of poverty to a greater or lesser degree. Montenegrin society is not an exception and the latest research data on the problem of poverty in Montenegro (according to Statistical Office of the Republic of Montenegro - Monstat) show that 11.3% of the population is poor and the largest number of poor people live in the north region (18.3%). It has been established that the majority of poor people and families have inadequate dietary habits, that they are more susceptible to numerous bad habits (tobacco and alcohol consumption, etc.), that they live in inadequate conditions, which explains the fact that the poor frequently suffer from chronic non-infectious diseases.

According to 2003 Census of population in Montenegro, there were 12617 illiterate persons or 2.3% of all the population of Montenegro. Average percentage of illiterate persons in Europe is around 1.5%. Of the total number of illiterate persons in Montenegro, 69% are older than 65 and 90.4% are women.

The younger population is quite literate with equal distribution between the sexes. At this moment, the largest number of people in Montenegro finished secondary school (48.4%), primary school finished 22.9%, vocational college 9.6% and faculty 7.5%.

Globalization process in poorly developed and moderately developed countries is associated with the trend of their population consuming unhealthy, high energy foods, with a lot of saturated fats, salt and sugar. Urbanization is becoming more prominent. Urban population is increasingly oriented towards sedantary lifestyle, which, combined with inadequate dietary habits, has led to the increase in numerous risk factors (obesity, elevated blood cholesterol and blood sugar level, elevated blood pressure) and the increase in cardiovascular diseases, diabetes mellitus and malignant neoplasms.

According to 2003 Census of population in Montenegro, urban population amounts to 38% and is increasing while rural population is remarkably decreasing.

The life expectancy in Montenegro is, according to the latest available data from 2004, 73.25 years (69.76 years for men and 76.09 years for women). These figures are considerably lower than the average figures for developed European countries (76-79 years for men, and 80-84 years for women, i.e., for both sexes somewhat less than 80 years), but are similar to other Balkan countries and its surroundings (source - Health for all database, WHO Office for Europe).

One of the most important health problems in Montenegro is death due to preventable causes that are the consequence of certain lifestyle: smoking, inadequate dietary habits, insufficient physical activity, alcohol and drug abuse, etc.

An overview of the health system and state of health of the population of Montenegro shows advances in the health of the population. The existing health care resources, within the framework of the public sector, indicate the accessibility and development of health care infrastructure, especially with regard to the number of beds and number of inhabitants (643 beds per 100,000 inhabitants in public health sector). The physician: population ratio increased and in 2005 was 1.97, that is, one doctor per 508 inhabitants (according to the data of the Fund for Health and the Ministry of Health for 2005).

The mortality rate of newborn babies in Montenegro, a very significant indicator of the state of health of the population and development of health care services, as well as an indicator for socio-economic, educational, cultural and other social developments, has a positive trend, and in 2004 it was 7.8 per 1,000 newborn babies. Besides lower mortality rate of newborns, mortality rate of children under the age of 5 has decreased, which also represents a sensitive data according to which UNICEF ranks countries. The rate of maternal mortality has had a zero value for years now, which indicates that in Montenegro there are no deaths as a consequence of pregnancy, delivery or postpartum period. Leading causes of death in Montenegro (according to disease groups by MKB-10) in 2006 were: bloodstream diseases (56.8%), malignant neoplasms (16.3%), injuries, poisoning and consequences of effects from external factors (4.9%), respiratory diseases (4.3%), diabetes mellitus (2.0%), other diseases (6.3%) and a high percentage (9.4%) of insufficiently defined conditions marked as symptoms, signs and pathological and clinical test results. Because of the high frequency of insufficiently defined conditions in Montenegro (in Serbia the frequency of these diagnoses in 2006 was 4.8%) a certain caution is necessary. (Source: Monstat - Statistical Office of the Republic of Montenegro). In the group of deceased persons the number of treated patients grew, while the number of untreated fell. Thus the ratio of treated : untreated in 1966 was 58.3% to 41.7% and in 2006 it was 94.9% to 5.1%

Health information system in Montenegro is insufficiently developed and unable to ensure quality in information to institutions that can use them to make priorities, make decisions about the creation of certain programmes and funds for their implementation. Health information system should, besides aggregating data about the health of the population, analyze the data about the frequency of diseases according to age, sex, ethnicity, with an aim to facilitate identification of inequalities in health status between certain groups of people. Having in mind the fact that certain data can only be obtained by complex research methods using nationally representative samples, it is necessary to provide means for strengthening of health institutions capacities that will conduct research and funds for financing the research.

Statistics of public health is not developed in the sense of monitoring the link between the environment and health, as well as the whole sphere of health care. It is thus necessary to develop professional standards, information system, define regulations for collecting, keeping and using the data, evaluate health programmes adequately and make more realistic reports.

High quality analyses dealing with socio-economic approach to health system in Montenegro are very rare. In numerous international comparative analyses of health systems there are hardly any relevant data about our country.

It is obvious that the health system of Montenegro is in the middle of rapid social, economic and technological changes. We expect the changes to continue in the future, as a result of restructured economic and social policy.

New mechanisms of insurance, restructuring and reform initiative in health care, privatizations in the health care sector, redistribution of human and other resources, decrease in public expenditure, new technologies and many other factors are becoming more prominent which should result in promoting better care for the quality of health care. It is necessary to do a comprehensive analysis and estimation of health needs and demands, availability of human, financial and other resources and, within the legal, organizational and financial frameworks, it is necessary to identify, suggest and implement certain changes.

The existing treatment of scientific activities in Montenegro is unsatisfactory. The results achieved on the basis of our own knowledge cannot help make changes and contribute to progress. According to available data collected by MONSTAT, we can show two types of indicators: Investments in scientific research activities and Monitoring of scientific staff. Government expenditure for RTD (Research, Technology, Development) in 2006 was 0.03% and the total expenditure for RTD was 0.04%. Montenegro cannot achieve the goal of EU and by 2010 start spending 3% of GDP on science. For the time being, until our economy grows stronger, investment cycles get more intense and profitable production capacities and their relations with service industry become more prominent, support to research, technological development and innovations has to be provided by intensive governmental measures. The government is responsible for influencing on socio-economic relations and creating conditions that enable healthy surroundings in which health of the nation is preserved and promoted. It is not only the most important goal and responsibility of the state, but also the most important prerequisite for the development of effective and efficient economy.

### **3.2. Directions of scientific research activities**

It is very difficult to envisage the future development of scientific knowledge and practice for the majority of health problems and diseases. Having in mind the fact that the large number of contemporary disorders are caused by more than one etiology factor, the decisions about which therapy to prescribe have to be made by using sophisticated analyses of risks for each patient, which is the only prerequisite for the success of medicine in future. In spite of the great success of medicine and pharmacy in the 20th and 21st centuries, it is necessary to have better understanding and make better interpretation

of all the data and results available to us, and to implement precise legislation that will enable both doctors and patients not to be the only ones to face the risks of making decisions about the use of new medical technologies. Modern world is faced with three basic problems in health care system: demographic changes, great expectations about treatment of health problems and new interventions in health care (new technologies). New technologies are becoming more numerous, more expensive but also more efficient than before. Using new medical technologies means that the old procedures which required that the patients spend very long time periods in hospitals will be replaced by new ones in outpatient clinics that carry out a large number of procedures. The examples are outpatient diagnostics of MRI (magnetic resonance imaging), fiber optical endoscope, arthroscope as well as ambulant surgery. Another example is the discovery of *Helicobacter pylori* and the successful nonsurgical treatment of ulcer caused by this bacterium; it shows that in future hospitals will be places where only conditions and diseases that cannot be dealt with in outpatient departments will be treated.

The use of a large number of pharmaceutical drugs enables the successful treatment of a large number of diseases that account for the largest percentage of patients in hospitals. Numerous new drugs aim at decreasing the incidence of atherosclerosis, coronary artery disease and, above all, heart attack and stroke. Newly developed pharmaceutical drugs make it possible to re-establish bloodstream through stenotic arterial blood vessels and dissolve clots in acute thrombosis. A large number of companies develop biotechnology products that can prevent, help to diagnose and treat numerous malignant tumors, above all breast carcinoma.

Treatment of infectious diseases also primarily aims at reducing the number of patients treated in hospitals. In future a careful treatment of two basic type of infectious diseases will be essential: the first type are those whose causes are resistant to antimicrobial drugs, and the second type are infectious diseases whose treatment requires hospitalization. The second type of infectious diseases also includes a growing number of chronic conditions caused by latent infections, such as ulcer caused by *Helicobacter pylori* or cancer of the cervix caused by viruses. In diseases such as progression of atherosclerosis, diabetes mellitus and malignant tumors (including hepatomas, gastric cancer and lymphoma) the role of infectious causes in etiopathogenesis of these diseases has been proved in some patients.

Fundamental research activities are the most important factor of the development of diagnostic tests and drugs. The application of laboratory research in diagnostic and therapeutic procedures represents the most important challenge of modern biomedical research. Finding the most adequate ways to accomplish this goal leads to faster development of more efficient methods of prevention, making a diagnosis and treatment of diseases.

**Key areas of biomedical research activities in developed countries will be subject to medical research in Montenegro as well, in accordance with our possibilities and the level of technological development: malignancy (breast carcinoma, prostatic carcinoma, colorectal carcinoma, leukemia, etc.), infectious diseases (HIV, SARS, hepatitis C), heart and lungs disorders (hypertension, acute infarction, chronic bronchitis), neurological diseases (Alzheimer's disease, multiple sclerosis, Parkinson's disease, cerebrovascular insult), disorders of the digestive, urogenital**

tract, diabetes (diabetes type I and II) liver cirrhosis, cholecystolithiasis, glomerulonephritis.

Cancer is a disorder with high incidence, prevalence, health care cost and social impact. Gastric, lung and breast cancer are key areas in this context. Particular areas of interest for researchers in Montenegro are: new strategies to fight cancer resistance to current treatments, and further development towards clinical trials.

Infectious diseases will remain for long time threat for human species and should be addressed every year. The focus should be on children population and on some specific topic not covered enough in the past.

In area of cardiovascular diseases the focus will be on diagnosis, prevention, treatment and monitoring of heart vessel diseases using broad multidisciplinary approaches.

Alzheimer's disease, Parkinson's disease, dementia and other neurodegenerative diseases affect millions of people and with the growing number of older people the number of the diseased is expected to grow. Even though researchers and clinicians have more knowledge about these diseases, it is still not enough for making a diagnosis and treating them. In large-scale multicentric studies researchers use advanced techniques for identification of biomarkers that can indicate whether a patient has certain neurodegenerative disease. Stroke and brain traumas are increasing with a high percentage of mortality and severely affect the quality of life of the ones who survive. The mission of scientists is to aim at improving the quality of life of people with neurological disorders through innovative researches (pathophysiology of the disease, prevention, development of new therapeutic strategies) and of clinicians to make fast and correct diagnosis and administer the best currently available treatment. Scientists and clinicians from Montenegro have to participate in some multicentric studies or projects with their colleagues from developed countries in order to address these issues.

The population of Montenegro, like the population of other developed countries, is increasingly affected by "Metabolic syndrome" whose components are type II diabetes, dyslipidemia and hypertension. A new treatment strategy as pharmaceutical modulation becomes an applicable and effective therapy for type II diabetes.

Physicians from Montenegro will participate in collaborative studies that deal with risk factors, prevention, and use of new therapies.

Human health and safety are influenced by a great number of environmental factors: chemical, physical and microbiological. A research effort in this area should reduce the hazardous impact on human being by enhancing knowledge about environmental factors, developing new methods for risk assessment and prioritisation of the effort.

According to the WHO, at a global level, unhealthy lifestyle will be the most important cause of disease and premature death in the coming decades. A strategic research effort will contribute to the creation of long-term behavioural changes in children, young people, adults and the elderly and through the development of measures that promote a healthy lifestyle, reduce the occurrence of lifestyle related disease and chronic disease.

Biomedical research include applied methods, such as genotypes, epigenetics research, analyses of gene expression, interfering RNA (RNAi) and proteomics.



The application of consistent, valid and standardized laboratory methods is essential for fast and efficient exchange of data between research teams that pass the information on from fundamental research to its application in diagnostic and therapeutic procedures.

Non-invasive surgery has considerably transformed numerous surgical procedures, including endoscopic surgery that has become a routine practice in a large number of surgical interventions.

Endovascular surgery develops in parallel to organ surgery, but faster and more efficiently. Today endovascular surgeons successfully operate intracranial aneurisms, efficiently remove aneurisms of abdominal aorta, and widen narrowed or stenotic arteries. Coronary angioplasty is still the most frequently used endovascular procedure, and experts in the field estimate that advances in the application of pharmaceutical drugs or preventive measures will not minimise the importance of endovascular surgery methods in treatment of coronary artery disease. Endovascular cardiology will make advances primarily by monitoring and making use of factors of angiogenesis, gene therapy of myocardium and stem cell technologies, combined with endovascular surgery methods. Advances in stent design and efficient methods of restenosis inhibition further develop the application of endovascular treatments. The implications of the use of this technology in hospital treatments will primarily lead to the reduction of open-heart surgery, an increase in capacities and staff, and treating of patients in laboratories for interventional cardiac catheterization instead of treating them in operating rooms.

Organ transplantation is a definite therapy for terminal organ insufficiency that can be caused by various etiological factors. However, the success of organ transplantation is frequently limited by graft rejection, side effects of chronic immunosuppressive therapy and severe lack of available donors.

Radiological images in digital format can be sent by electronic devices, classified, analyzed and filed away, and then retrieved and analyzed again at any moment within local or wider network, including surgeries. Images filed away in communication systems are more efficient and bring numerous advantages, such as a decrease in the number of staff that develop films and puts them in the archives, and there is no need for keeping films and no expenses for their development and other equipment used for that purpose.

Electronic databases of radiological images and histological preparations, that are available at any time, play an important role in treating patients adequately and in medical education and research work. Advances in all kinds of treatments, especially surgical ones, are enabled by expert consultations by means of 'real time' links that use internet connections.

In today's world control of non-infectious mass diseases as well as control of outburst of infectious diseases into epidemics in different continents will be possible primarily by using information technologies, that is, by timely sharing of information about adequate possibilities for control and therapy of these diseases.

An increase in the use of information technology methods and telemedicine can bring significant advances in health care of many developing countries, having in mind that the World Health Organization (WHO) included telematics as the main means in "Health for all" strategy. International telecommunication union organizes regular international conferences and symposia whose aim is to promote the use of new information technologies of telemedicine in developing countries.

Evidence based medicine is thought to be the bridge between practice and scientific research. Application of medical knowledge based on evidence in everyday practice implies the use of the best information and evidence available in the process of decision making about the care for each patient. With precise definition of clinical problem and evaluation of available information from the clinical aspect, the doctor will possess the best evidence that medicine is able to give and he will use it in the process of making relevant decisions about further clinical work. Although evidence based medicine significantly improves and simplifies evaluation of clinical research, these techniques are not always available to everyday needs of clinicians.

**The most important factor that will enable the development of medical scientific research activities is, above all, adequate education of professionals, both at graduate and postgraduate level.**

**The process of educating students at medical schools has to include lectures given by visiting professors and scientists from abroad who can adequately present results and new tendencies of development and application of technologies in medicine. Higher education institutions should keep updated and be able to provide high quality education, to stimulate students to continue with scientific activities in the country and abroad and to create conditions for young researchers to make advances in the academic world.**

#### **4. SWOT analysis of medical scientific research activities in Montenegro**

##### **Strengths**

- Overall vision of the health care system development
- Increase in scientific potential and scientific staff (number of doctors of sciences and masters of sciences)
- Existing possibilities for educating medical staff at domestic institutions
- Increase in the number of research activities and published papers and books, collections of papers, articles in the country and abroad
- Possibilities for professor and student mobility with an aim to improve their knowledge
- Readiness of scientists, professors and associates to adapt to changes brought by modern scientific and technological progress
- Integration of health care system into the international health care system and significant support by international institutions in that respect

##### **Weaknesses**

- Poor treatment of science
- Low amount of financial support from GDP for scientific research activities
- Insufficient investment into development of scientific research laboratories
- Absence of stimulative measures for doing scientific research activities
- Lack of scientific research infrastructure
- Lack of networking with international scientific teams
- Lack of strong economy able to support and use the results of scientific research activities
- Lack of state mechanisms for popularisation of scientific research activities
- Small number of basic medical research

##### **Opportunities**

- Possibilities to make use of financial, professional and technical support through participation in programmes funded by European institutions
- “The Bologna process” – new opportunities
- Establishing cooperation with scientific institutions and university units of elite universities
- Transfer of knowledge of scientists and professors that spend long periods of time at elite universities abroad
- Engagement of young researchers on projects that best contribute to valuation of objective reserves and resources

##### **Threats**

- Insufficiently defined, stable and stimulative surroundings for the development of scientific research activities can prevent or slow down their integration into the European scientific space
- Insufficient investments into public health institutions and hospitals and outdated equipment
- Physician:patient ratio in Montenegro is lower than in Europe
- Scientists will be oriented towards health care, teaching and administrative work
- The most talented researchers move to countries that offer better opportunities for science research activities

## Annex I – List of national projects in the field of medicine in the last ten years

Institution	Type of reserach activity	Title of nationally funded project
Ministry of Education and Science – Department of Science	Scientific projects – 1999-2007	<ul style="list-style-type: none"> <li>• Alcoholism among industrial workers in Montenegro</li> <li>• Management of human resources in health care</li> <li>• Study of influence of quality control of preoperative and postoperative radiotherapy on treatment results</li> <li>• Segmental distribution of liver echinococcus – anatomical conditions and etiology</li> <li>• Quality of life in patients with chronic diseases that lead to physical disablement</li> <li>• Importance of Escherichia coli in epidemiology and pathogenesis of urinary infections</li> <li>• Epidemiological study of lung cancer</li> <li>• Clinical experimental study of timely diagnosis and therapy of early abortions</li> <li>• Bronchus carcinoma – problems with diagnosis and treatment</li> <li>• Study of the best treatment available for the diseases of peripheral blood vessels</li> <li>• Polygene inheritance of quantitative phenotypic characteristics and cytogenetic study of people at risk in certain population groups in Montenegro</li> <li>• Chemical properties of drinking water in karstland of Montenegro as an element of their protection</li> <li>• Venous path and elevated intra oxal pressure of deoxygenated blood in spongius parts of the bone as a risk factor in development of degenerative osteoarthritis of skeletal system and spine</li> <li>• Allergy to beta-lactam antibiotics</li> <li>• Incidence of breast bone deformity in last</li> </ul>

		<p>ten years and its treatment</p> <ul style="list-style-type: none"> <li>• Eye diseases and injuries as a cause of disability in children and adults</li> <li>• Early diagnosis and prevention of male sterility by means of elucidating major etiological cause of varicocoele in population between 12 and 18 years of age</li> <li>• Etiological and clinical characteristics of acute pancreatitis in Montenegro with an emphasis on diagnosis and treatment</li> <li>• Homicide in Montenegro – medicolegal aspects of expertise of homicide victims</li> <li>• Longitudinal follow-up of children with congenital heart diseases in Montenegro with an emphasis on the quality of life of operated children</li> <li>• Drug addiction among young people in Montenegro</li> <li>• Cytochemical, cytogenetic and morphological characteristics and features of malignant diseases of haematopoietic system and effects of cytostatic treatment</li> <li>• Etiological factors of hirsutism development in girls and young women in Montenegro with a focus on enzyme 21-hydroxylase deficiency</li> <li>• Gastroduodenal ulcer in Montenegro with a focus on etiology and modern surgical treatment</li> <li>• IUGR probable consequence of abnormal placental development</li> <li>• Characteristics of tick transmission zoonosis in Montenegro</li> <li>• Placental bloodstream – abnormal development</li> <li>• Prognostic importance of heart frequency variability in patients with acute myocardial infarction</li> <li>• Frequency and possibility of detection and prevention of partial deafness in children</li> <li>• Importance and validity of immunohistochemical and enzymochemical methods in diagnosis of malignant lymphoma</li> <li>• Hemoembolization in treatment of patients</li> </ul>
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		<p>with primary and metastatic liver tumour</p> <ul style="list-style-type: none"> <li>• Ivus in diagnosing development of restenosis on coronary blood vessels and follow up of pathobiochemical parameters (adensive molecule, cytokine Lp(a) lipoprotein oxi-ldl, sod, mod) in its pathobiomechanism in “drageluting stents” in the population of Montenegro</li> <li>• Malignant epithelial tumours of oral mucous membrane in Montenegro</li> <li>• Cystohistological and clinical research of vascular remodelling in coronary and blood vessels diseases</li> <li>• Use of cystine C as a screening test in early diagnosis of diabetic nephropathy</li> <li>• Rational therapy of Lyme borreliosis syndrome</li> <li>• Influence of statins on lipid fraction in patients with coronary disease</li> <li>• Bronchus carcinoma in Montenegro</li> <li>• Malignant haematologic diseases</li> <li>• Morphological cysto-hystological and immunochemical characteristics of arterial and venous blood vessels in diseases</li> <li>• Syndrome of malnutrition of inflammation and atherosclerosis in patients on haemodialysis</li> </ul>
Montenegrin Academy of Science and Arts		<ul style="list-style-type: none"> <li>• Antisocial behaviour in medical science</li> <li>• Antisocial behaviour in medical science and practice</li> <li>• Time differences between biological and chronological aging</li> <li>• Development of surgery in Montenegro</li> <li>• Specific characteristics of risk factors of spontaneous and intracranial haemorrhages</li> </ul>

## Annex II – Research projects approved by Ethics Committee of the Clinical Center of Montenegro

	<b>Research title</b>	<b>Type of study</b>	<b>Field of study</b>
1	EORTC TRIAL 1002	Experimental study	Clinical study
2	ANTIBIOTICS IN THE TREATMENT OF PRETERM BIRTH	Analitical study	Clinical study
3	ROLE OF TRANSOESOPHAGEAL ECHOCARDIOGRAPHY IN DIAGNOSIS OF MYOCARDIAL ISCHAEMIA DURING OPERATION	Analitical study (Cross sectional study)	Clinical - Cardiology
4	OPTIMIZATION OF THREE-DIMENSIONAL TREATMENT PLANNING FOR RADIOTHERAPY OF INOPERABLE NON-SMALL CELL LUNG CARCER	Analitical study (Cross sectional study)	Clinical - Oncology
5	CLINICAL RESEARCH OF PHASE IV, THAT IS, USE OF «ZOMETA» MEDICINE	Experimental study	Clinical - Oncology
6	RANDOMIZED MULTICENTRIC RESEARCH OF PHASE III, AIMING TO COMPARE THE USE OF DOCETAKSEL EVERY THIRD WEEK WITH THE USE OF DOCETAKSEL EVERY SECOND WEEK IN PATIENTS WITH METASTATIC BREAST CARCINOMA	Experimental study	Clinical - Oncology
7	MULTICENTRIC STUDY AIMING TO ASSESS THE DEVELOPMENT OF ATTITUDES OF YOUNG PATIENTS (YOUNGER THAN 35) WITH BREAST CARCINOMA WITH RESPECT TO THE RISK OF INFERTILITY CAUSED BY ANTI-CANCER THERAPY	Analitical study	Clinical - Oncology
8	IMPORTANCE OF AUTOANTIBODIES IN THE PROGNOSIS OF THE COURSE AND OUTCOMES OF LUPUS NEPHRITIS	Analitical study	Clinical - Nephrology
9	RANDOMIZED, MULTICENTRIC, DOUBLE BLIND STUDIES OF PHASE IV, AIMING TO COMPARE BISOPROLOL WITH KARVEDILOL IN OLDER PATIENTS WITH CHRONIC HEART INSUFFICIENCY (CIBIS-ELD)	Experimental study	Clinical - Cardiology
10	CHANGE FROM PHASE II TO PHASE III OF	Experimental	Clinical -

	RANDOMIZED, MULTICENTRIC, DOUBLE BLIND STUDY AIMING TO COMPARE BISOPROLOL WITH KARVEDILOL IN OLDER PATIENTS WITH CHRONIC INSUFFICIENCY	study	Cardiology
11	CLINICAL RESEARCH OF PHASE III UNDER THE NAME «ANDES-STUDY FOR THE EVALUATION OF AGI-1067, AS A NEW ANTIDIABETIC AGENT»	Experimental study	Clinical - Endocrinology
12	PHASE III OF RANDOMIZED CONTROLLED RESEARCH OF PICOPLATIN AND THE BEST SUPPORTING THERAPY (BST) WITH RESPECT TO BST ALONE IN PATIENTS WITH REFRACTORY OR PROGRESSIVE SMALL CELL LUNG CARCER (SCLC) IN THE PERIOD OF SIX MONTHS AFTER THE COMPLETION OF THE FIRST LINE OF PLATINUM-BASED CHEMOTHERAPY	Experimental study	Clinical - Pulmology
13	INTERNATIONAL POSTMARKETING NON-INTERVENTIONAL OBSERVATIONAL STUDIES IOS (INTERNATIONAL OUTCOME STUDY) DURING THE USE OF NOVO NORDISK MEDICINE NORDITROPIN	Descriptive study	Clinical - Endocrinology