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SCIENCE AND RESEARCH IN THE COVID-19 PANDEMIC

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Abstract: *The crisis of the COVID-19 pandemic has affected the world on a global level in all segments of life and work. It is accompanied by other crises, such as: fires, floods, earthquakes and all the way to changes at the geostrategic level in the political, military and other segments. All of the above happened and is happening at a time when science and research have reached their highest point, because a greater number of inventions, innovations and other achievements have happened in the last few decades than in the entire history of civilization. Medical science has advanced in all its branches, ie subsystems. Despite that, there was a massive health infection with a large number of human victims. A new virus has emerged, but the old ways of preventive action and crisis management of health infections still remain.*

The C-19 pandemic had a twofold impact on science and research: positive and negative.

The positive impact was manifested in the sphere of rapid invention of the vaccine, ie rapid development of diagnostics. There has been greater integration, but also mobility of experts and scientists in the exchange of scientific information, writing joint papers and joint research on the topic of the pandemic. At the time of the pandemic, reference scientific journals and studies were popularized, the number of papers and studies on the topic of the pandemic increased, some industries such as the pharmaceutical, medical equipment industry, artificial intelligence and robotics experienced progress, etc.

Nevertheless, the COVID-19 pandemic has also shown its negative sides. It took a large number of human lives. There has been a prolonged closure of economies, but also of people, with numerous restrictions, prohibitions and human rights violations at the global level. The scope of COVID - 19 and the extent of negative impact should be considered not only until its completion, but also in the long run, because after the health crisis, the following crisis will either appear or deepen: mental, economic, moral, political and other crises. They will no doubt be far more complex and long-term to address.

However, the burden of the pandemic crisis was not evenly felt by all countries at the global level, by all structures of society at the national and global level and by all economic branches. Some branches have even prospered in the pandemic, such as the pharmaceutical industry. The pandemic crisis was used to strengthen autocracy as a way of governing nations, under the pretext of caring for the population and protecting the life and health of the population.

This paper aims to point out some of the problems in the management of science and research during the pandemic, with special emphasis on medical science, and relations with alternative medicine, private health, but also with non-medical

sciences, primarily management, organization and crisis management. The paper also points to the application of new strategic tools in crisis management of the C-19 pandemic, but also to a new view of science as a new productive force, and the strengthening of strategic tools in resolving the pandemic crisis.

The paper presents a critical reflection on the C-19 pandemic from the point of view of (non)-medical, ie managerial organizational science and profession. At first glance, this may be a problem, as non-medical professionals are entering the realm of a pandemic that is primarily a medical problem. However, there is no conflict here, nor can there be, because the starting point of the author is that the pandemic is half a medical and the other half a non-medical problem, and that this phenomenon should be considered in a broader context because many innovations of technological and organizational type were created by chance.

Keywords: *Pandemic, Covid-19 non-medical approach, Problems of science in pandemic, Problems of research in pandemic.*

INTRODUCTION

The pandemic has limited many activities. In the scientific-research sphere, it marked the beginning of the third decade of this century with two opposing tendencies: that many research and innovation institutions were closed, and that on the other hand, a vaccine against the Covid-19 virus was found in a relatively short period of time. In other words, conditionally speaking, in the Covid-19 pandemic, the pharmaceutical industry was the winner, while general scientific and innovative research was limited by certain restrictions, prohibitions, and even financial possibilities. (Callaway E. et al., 2020.)/1/

Prohibitions, restrictions, the closure of people, businesses, and the disruption of supply chains have called into question the survival of many industries. This has happened and continues to happen with science, research and innovation. Estimates say that since World War II, there have been no larger disruptions in scientific, innovative, and other research than have been disrupted by the Covid-19 pandemic. It will leave even bigger consequences after it ends, because the so-called post-pandemic crises that will be more complex will emerge and it will take considerable time to find solution for them.

These three pillars on which the success of every national economy, but also the world at the global level, are based, strive to provide sustainable financing. In the field of science and research, the pandemic has especially affected young researchers, students, women researchers, talent attraction programs, internationalization of studies, etc.

Acceleration and synergy of science, research and innovation have never been more needed by the world, because today there are integrated crises such as: climate change, economic crises, war conflicts, earthquakes, floods, fires, volcanic eruptions and mass health infections. Integrated problems should be answered in an integrated, ie multidisciplinary manner. Regarding the above, "OECD-Science, Technology and Innovation OUTlook 2021, published in January 2021, pointed out that Covid-19

threatens to cause long-term damage to innovation systems at a time when science and innovation are most needed." (Maher B, Van Noorden, R. 2021.) /2/

The focus of states on resolving and ending the pandemic will reduce spending on science, research and development. Reduced economic activities and activities of companies will objectively reduce the possibility of inflow of funds for science, research and innovation. In countries where the economy finances universities and their activities outside national budgets or via philanthropic organizations, the pandemic will make the functioning and sustainability of science even more difficult. The situation is the same with the further development of artificial intelligence.

Nevertheless, the pandemic has accelerated innovation processes that have enabled work from home, learning, ie education from home, virtual holding of international scientific conferences, scientific gatherings and exchange of knowledge through information and communication technologies. This significantly increases the potential, because it allows a far greater presence of people than the classic ways; it also reduces costs and provides greater comfort, ie the comfort of participants in this business. It is estimated that these changes would not have taken place with such dynamics if the pandemic had not accelerated its pace.

1. SCIENCE IN THE COVID-19 PANDEMIC IN SERBIA

It is known that science has become a key factor for the progress of humanity in the new millennium. It turns out that man has acquired a larger quantum of knowledge in the last few decades than in the entire history of civilization. Many countries are removing obstacles and limitations in the promotion of science making it known that science is also changing, thanks to new knowledge, which means that it is a dynamic and never-ending job. (Narajan, V. i drugi, 2021.)/3/

The COVID-19 pandemic has changed the attitude towards science and scientific, professional, innovative and other research, analysis, etc. The emphasis in the pandemic is on health systems, ie on preventive protection and treatment of the population. In a relatively short time, medical science has found the vaccine as a basic tool for preventing, or mitigating, the consequences of a pandemic. The scientific infrastructure has also been built, when it comes to: laboratories, covid centers, covid hospitals and diagnostic tools, all the way to technological medical systems in the treatment of covid virus and other pathogens as well.

The objective problem that arose before medical science is the understanding of science, official, ie factual and quantum medicine, and the relationship between certain medical branches, especially between epidemiology, virology and immunology. The lack of understanding of science and the lack of understanding of relationship between certain sciences and professions has led to numerous problems in pandemic management, as well as in outcomes related to the pandemic.

The first problem that appeared in the management of the pandemic crisis was a complete understanding of the anatomical and physiological characteristics of the C-19 virus. This is also a condition for opposing and fighting the virus, because in the theory of organization, it has been scientifically proven that only what is well known can be managed successfully (efficiently and effectively). As the knowledge about the C-19 virus is partial, there is a need for science to get to know its specifics in relation to other viruses that belong to the same type of virus. Thus, the C-19 virus, by being classified as a SARS species, has some common characteristics with other types of viruses from that group, which science has established, but there are also unknowns that even in a minimal amount represent a bigger problem than what science has managed to determine. In other words, in science, one percent of the unknown is worth more than 99% of the known. Due to unknown specifics and partial knowledge about the COVID-19 pandemic, man, ie medicine is not able to provide an adequate answer to this challenge, which is logical because without a complete knowledge of the research subject, there is no quality crisis response. (Vucenovic, V., et al., 2011.)/4/

The second problem is that the classical scientific method is still widely represented, which created classical science with a high level of determinism. This is manifested in the understanding of science as absolutely accurate, ie there are claims that the world is organized in the way that science has determined. It must be borne in mind that in the natural and social order there is nothing that is absolutely true. Accordingly, there is no absolutely accurate science or results of scientific research in medical science.

Therefore, in science in general, and similarly in medical and every other science, the classical Cartesian scientific method must be abandoned that the universe is organized exactly according to the laws and rules established by science. This must be transformed into the attitude that the world is probably organized according to the laws established by science. In other words, it is probably as science has determined. The introduction of statistical probability in science, ie medical science, eliminates determinism and the mechanistic understanding of science but also of the universe which was advocated by classical scientists. In other words, "the discovered knowledge that every object and manifested problem must be viewed in connection with the relations it establishes with the elements of the environment has strengthened the view that only in this way can the causes of the established condition be determined. It also marked the beginning of the constitution of a qualitatively new scientific method that provides the conditions for creating a more objective view of the objects of observation or the problems manifested." (Vucenovic, V., Lekovic, B., 1998.) /5/

This analogy can be fully applied in the scientific research of C-19, where it is necessary to understand the virus as self-organization, as the most perfect form of organization. Its specificity is that it has its own mind, ie its own intelligence, but also the ability to adapt, ie to mutate and to survive thanks to that. It turns out that in the natural order, it is not the strong who survive, but those who are able to adapt to certain natural changes. Of course, the virus will continue to survive until man fully understands its anatomical and physiological side and finds a means of protection, ie prevention. That is why it is important for science to understand C-19 as a self-organization, with a high degree of adaptability. (Radosavljevic, Ž. et al., 2011.). /6/

By understanding the C-19 virus as a self-organization, doubts about its order are removed and conspiracies regarding the origin of this pathogen are eliminated. It has been proven that all types of self-organization arise in a natural order and are the result of natural influences and laws, because it is a scientific fact that everything that exists in the cosmos is the result of a natural process of organization. Accordingly, the fight against C-19 should be sought in medicines that will be based on natural substances.

By introducing probability, science but also the world, should be viewed changeably. This means that medical science is not absolutely accurate, but that it also operates at the level which shows different degrees of probability. In each new dimension of time, medicine finds new drugs, or ways of treatment, which are often the opposite of the existing ones. In other words, thanks to the progress of science, new drugs are being found that have a smaller undesirable by-product, ie drugs that have a higher degree of probability, ie efficiency, but also effectiveness. So, no cure, vaccine or other medicine is absolutely reliable in the treatment of any disease, but everything is happening at the level of probability.

The pandemic confirmed the above findings, because new causes of the virus are permanently being determined, thanks to new ways of analyzing blood samples, all the way to the change in the attitude towards wearing medical masks, etc. The appearance of at least one deceased has created a tendency to doubt the correctness of the vaccine, not realizing that there is no absolute accuracy in vaccines as a product of science, nor can there be. In other words, the vaccine, as well as other pharmaceutical products, is probably the best solution for the fight against the virus for now, and it does not provide 100% reliability in the cure of those infected with the virus. The medical profession in this way should explain the effects of vaccines, which would reduce resistance and the creation of so-called anti-vaccine movement worldwide, which is a major problem in the fight against the pandemic.

The third problem lies in medical science itself, because it is divided to such an extent that the integrity of the science of man is lost, that is, the holistic approach to the observation and treatment of man is lost. Although holism first originated in

medicine, it is today neglected to such an extent that often a virologist does not have enough, or even a minimum of knowledge from epidemiology, immunology and vice versa. This is evident even at professional medical gatherings where virologists often point out that they are not epidemiologists and that the field is outside their scientific professional field of activity. The narrow specialization in medicine has led to the loss of the whole human being, which has imposed the need to propose the so-called "precision medicine, advocated by a range of American experts, entrepreneurs and politicians since 2015. This has led to a significant effort to reorganize the interests of political programs in academia, governments and industries."

This shortcoming in science leads to the problem of a pandemic being considered partially, which is why partial solutions are made that give effects at the level of a part of the human organism, but it is possible to cause damage to other parts or to a human as a whole. Regarding the above, Aristotle says: "The part is important, but the whole is much more important and that for the sake of the whole, even in medicine, certain parts can and must be sacrificed." (da Silva, L., 2021) /7/

Although medicine is a practical science, national public health organizations, as well as the World Health Organization, have not practically responded to the challenges of the pandemic. The reasons for this should be sought in the fact that there is a large gap between practical and theoretical knowledge. Epidemiology as a branch of medicine is taught at the faculty, but practical knowledge is acquired in practice, in covid centers, clinics, covid hospitals, next to covid patients and in communication and cooperation with the medical and non-medical part of the health institution. Since pandemics are occasional, there is no real situation for gaining experience, and when a pandemic occurs, the medical epidemiological profession is unprepared. The final outcome is a large number of human casualties, which was evident in the initial stages of C-19 even in the most developed countries of Europe (Italy and France).

2. THE NECESSITY OF MARGINALIZATION OF MATHEMATIZATION IN MEDICAL SCIENCE AND THE NEED TO INTRODUCE MEDICINE INTO THE SOCIAL SCIENCES

The pandemic is not only a medical but also a non-medical problem. It is estimated that 50% of pandemics are medical and the other 50% are non-medical problems. This is easy to verify, because technical sciences and professions, natural, to social such as management and organization, holistic theory, systems theory, operational, information, technical technology and other sciences are used in preventive protection against pandemics. This is understandable, bearing in mind that today it is difficult to imagine any system from primary health care that can

respond to certain challenges without having modern medical equipment and the people who maintain, manage and use it for medical purposes. So, engineers, technologists, programmers, IT experts in the field of artificial intelligence are a necessity for every health system.

On the other hand, it should be borne in mind that a pandemic is a global crisis with the highest degree of risk. It turns out that the fight against the virus can be considered as a global war in which material, human, information, financial and other resources are engaged. This war does not end with the disappearance or victory over the C-19 virus, but will continue even after the pandemic is declared over. In all parameters and consequences, the pandemic exceeds the damage of even the classic war conflicts in the past, which imposes the need for this fight to be waged using science and knowledge of the so-called neocortical warfare. (Pajic, S., Radosavljevic, Ž., Anđelkovic, A., 2020)./8/

The previous findings lead us to re-examine the place and role of mathematics in medical science and the place of medical science in the social and humanistic sciences. Regardless of the importance of mathematics in proving certain phenomena, processes, trends and outcomes, it is shown that excessive insistence on mathematization in medicine is counterproductive. This is because medicine deals with living beings and humans, but also with viruses that are also living, but also highly intelligent and adaptive beings. The general effort to predict and program medical processes and procedures through mathematical and statistical sciences is unacceptable, because it is evident that each person is a unique and indivisible whole, which makes him specific in relation to other resources and elements of the organization that can be predicted and programmed.

Hence the conclusion, which has already been provided, that the probability in the application of appropriate knowledge of medicine in humans is accompanied by a lower degree of probability in relation to material resources. Predictions regarding the duration of the pandemic, its peak, declining trend, and the beginning of new waves of the pandemic proved to be wrong, which led to a number of unfavorable consequences for individual national communities. In short, medical science, like man, cannot be programmed.

On the other hand, it is necessary to introduce medical sciences, especially neuroscience which deals with the human neocortex, that is, emotional and motivational intelligence responsible for everything that exists on the planet Earth, into the social-humane sciences. Excessive application of technical, mathematical and other deterministic sciences based on theorems and numbers is counterproductive. Insufficient application and representation of medicine, psychology, moral science and others has led to numerous challenges in the social sciences, but also when it comes to managing the COVID-19 pandemic. It is especially important that the

achievements of medical science in terms of provability of individual decisions or actions are based on facts, assessments, priorities and the high level of professionalism that exists in the medical profession. It is good that the medical profession is relatively closed to the entry of incompetent individuals, so this practice should be applied to other professions in the field of organization, management and other sciences.

The above facts are important, because every health system and the people who are employed in it should be treated as medical staff. So, a driver who drives an ambulance, a technologist who maintains machines and robots in the institution, a cook, a recorder and a statistician who deals with the number of infected, dead, on a respirator, etc. they all should have the status of medical staff. If only one of the mentioned professions fails, there is a problem, which is natural, because the strength of the chain is determined by its weakest link. Each segment of the Covid system should be viewed uniquely and in conjunction with the other.

3. SPEED OF DISCOVERING THE VACCINE AGAINST C-19 - GOOD OR BAD THING?

In modern scientific and technical progress and development, time has become the limiting factor of every action or inaction. Unlike in the past, today time is measured in nanoseconds, with the general tendency for individuals, as well as organizations, to make the greatest possible impact in a unit of time. In other words, today the speed of action has become a condition of survival, which is embodied in the natural order, where Darwin's thesis that "the stronger swallow the weaker" has been replaced by the phrase "the faster swallow the slower".

In the management of the C-19 pandemic, there is a problem of misunderstanding regarding the speed of finding vaccines and other medical tools and drugs. In the past, new products and innovations in general took a long time, due to the reduced quantum of knowledge, but also insufficiently developed technologies that slowed down many elements of the innovation or scientific process. The research was based on a partial approach and insufficient, ie slow exchange of information and knowledge, so that there was a significant time span from the idea to its operationalization, which led to pandemics that lasted a long time, and the fight against viruses was conducted in primitive ways.

In modern conditions, science has managed to find a vaccine in a very short time, and the pharmaceutical industry has managed to produce it and make it available to health systems. A year after the C-19 virus appeared, the World Health Organization announced that "more than 200 vaccines are being developed, of which approximately 50 are in various stages of clinical trials." Regulatory bodies have also responded and issued appropriate documentation and approvals for the use of

vaccines from various manufacturers. This practice has not been recorded in previous cases, because it was assumed that vaccines would be researched for a decade or more.

In the conditions of the pandemic, a vaccine was found relatively quickly, which provided protection against C-19 infection. Well-known virologist Teodor Hazioanu from Rockefeller University in New York stated: "We have never progressed so fast with any other infectious agent."

This has led to a number of misunderstandings. The global population has been confused by the speed with which vaccines have been found by pharmaceutical companies, given that previous vaccines against other viruses took more than a decade. This reaction was not justified, because modern science has advanced, gained new knowledge and with the application of artificial intelligence tools, and the integration of several companies, even states, a vaccine has been reached that is able to protect the population from mass infection. This is to the extent that science has identified the type of virus and the group to which it belongs, and that the findings from treatment against earlier viruses can be partially applied to the C-19 virus.

The fact is that the speed of finding the vaccine as a cure for the C-19 virus was influenced by the commercialization of the pharmaceutical industry and the pharmaceutical lobby, which, united with medical and political structures, seek to produce and market a new medical product. It is also a fact that many countries and pharmaceutical companies, in partnership with the World Health Organization and public health institutions, have managed to license certain vaccines without sufficient medical evidence and validated experiments, which has further increased mistrust and resistance to the vaccine. The data shows that the revenues and profits of the pharmaceutical industry have increased significantly in the last two years and that the basic structure of their profits is represented by revenues from vaccines or the sale of protective equipment, ie medical technology. In a word, vaccines and protective equipment and technologies that are in the function of fighting the C-19 pandemic have become goods, which they really should not be. The fact that vaccines are not available to the poor and low-income countries because they are not able to pay for them speaks enough about the direction and goals of the pharmaceutical industry on a global level.

The opinion that the speed of finding the vaccine is one of the symptoms of its poor quality, and that it is the result of commercialization in the pharmaceutical industry has led to mistrust and the creation of anti-vaccine movements, which oppose the vaccine. It is known from the theory of new product development that in addition to the introduction of a new product, appropriate promotion, information and acquaintance with its potentials should be provided. This was marginalized in the discovery of the vaccine, which is why vaccines were obtained relatively quickly,

but they did not have users, due to poor promotional and informative activities, both in the medical profession and the general population.

4. DID SCIENCE, AND ESPECIALLY MEDICAL SCIENCE DURING THE PANDEMIC, IMPROVE ITS REPUTATION, OR DID IT REDUCE IT?

It is known that everything that exists on the planet earth is the result of science, that is, new knowledge and insights, which man acquired by observing nature and its functioning, and by drawing certain laws. However, at the time of the pandemic, science, and especially medical science, lost the traditional trust of the citizens on a global level. Experience shows that trust in the medical profession was at the highest global level and that during the pandemic that trust declined. Although medical and pharmaceutical science has done a lot to improve human health, but also life expectancy, the pandemic crisis made the medical profession face a special challenge. The reasons for this are numerous.

Everyday experiences, especially in transition countries, but also in developed democracies, show that the medical profession was under great pressure from political structures and that the pandemic was run by political elites, instead of being run by the medical profession trained to fight this pathogen. Thus, the lives of people in the pandemic were marginalized, and political interests, ratings of political groups gained importance. The medical profession, which was not unified in defending its profession, is also responsible for the above.

Analyzes and everyday practice show that medical science during the pandemic was exposed to numerous attacks and pressures by party leaders, or members of the ideological group in power, even in democratic countries. In this regard, it is stated: "There has been an escalation of attacks on science and expert opinion, the intrusion of party politics into public agencies, especially the CDS Centers for Disease Control and Prevention and the US Food and Drug Administration (FDA) and the lack of national coordination. These respected and reliable public health institutions have become the target of direct and dangerous political interference by parties, which have often discredited science and scientific independence in general, especially of these institutions." The question is and a dilemma remains, what happened in the pandemic in terms of the reputation of science, ie its denial, when it is known that American society was built thanks to the leading scientific achievements of this country in various sciences and their branches. (Hooper M, Napoles AM, Perez-Atable 2020.)/9/

The disunity of the medical profession in terms of the success of protecting the population from mass infection has further called into question the trust of medicine as a science. A large number of the medical profession also expressed distrust towards

the vaccine, as a means of protection and treatment of the population. A number of the medical profession have publicly said that the C-19 virus is similar to the common flu, that the number of deaths from C-19 is far less than the death rate from other diseases and that the danger of this virus is overestimated, and that other vicious diseases during the pandemic have been marginalized. Numerous and unclear, but also contradictory decisions and statements of medical and political structures additionally influenced the distrust of the population towards the measures recommended by the medical profession. This and other misinformation spread at almost the same rate as the virus.

In the initial phase of the pandemic, medical science applied the same or similar measures against infection as it did several centuries ago. It is evident that man has conquered the universe and the depths of the sea, that man is able to create artificial intelligence with the goal of creating a thinking machine, and that medical science has failed to recognize the characteristics of a virus that will be declared a great danger to life and health in the 21st century.

5. COOPERATION OF SCIENTISTS AND RESEARCHERS DURING COVID-19

Related to the previous issue is the issue of cooperation between scientists and researchers during COVID-19 on a global level. Closures, restrictions and bans have had a negative impact on collaboration between scientists and researchers, requiring them to search for alternative ways to collaborate. The way out was found in the application of information and communication technologies that enabled research to be performed remotely. However, many long-standing connections in research at the international level have either slowed down or have been severed, with little prospect of renewing them, either due to their disappearance or the fluctuation of scientists and researchers. There is also the factor of moving to other scientific institutions at home and abroad.

The criteria by which the quality of scientific papers was evaluated during the pandemic is also problematic, because the value of scientific papers was dominated by the Index of Scientific Citation, and the number and scope of scientific papers in the databases of international journals. It turned out that the National Policy of China, ie their Government in 2020 stated that “Chinese researchers should be evaluated less on the basis of the volume of their work in the databases of international journals, and more on the quality of their papers. The results achieved and published in China should be taken into account”. (10/ How will Covid-19 reshape science, technology and innovation, OECD, 22 June 2021.). /10/

It turns out that scientific cooperation during the COVID-19 pandemic varied vastly. For some, the pandemic made research and collaboration difficult, while

others in the crisis sought a way to overcome the obstacles that made the research difficult. Here, as in other areas, it has been shown that "Those who want cooperation in the field of science, especially in times of crisis, will find ways to achieve that, while those who do not want will find an excuse or reason to explain why it is impossible."

Scientific cooperation had different dynamics during the pandemic. At the beginning of the pandemic, researchers were more focused on researching health infections and finding vaccines, ie they were focused on medical sciences, while other areas, even in national budgets, gained less importance. It turns out that "Never before, say the scientists, have so many researchers focused on one topic at a time and with great urgency to the point that almost all other research has stopped or has been interrupted." (Matt Apuzzo and David D. Kirkpatrick: "Covid-19 Changed How the World Does Science, Together",

[www.nytimes.com.translate.goog/2020/04/01/world/europe/coronavirus-science-research-cooperation.html?](https://www.nytimes.com.translate.goog/2020/04/01/world/europe/coronavirus-science-research-cooperation.html?_r=1&_gl=1), pristupljeno 30.07.2021.)/11/

According to the analysis of bibliometric data, it can be stated "that international cooperation was less common in the papers related to COVID-19 in 2020 than it was in the research of other coronaviruses in previous years." It is evident that with the spread of the pandemic, the number of papers whose authors were from the same country grew and that these papers occupied most of the literature on COVID-19. Looking at international cooperation as a whole in science related to COVID 19 it can be concluded that it was at the level of previous years for similar research. It is clear that such papers have less potential, especially since individual authors even appear from the same scientific institution.

The data show that in science and research there is a trend of weakening international cooperation. Research shows that cooperation between scientific research centers and institutions between the United States and China, as the two countries with the strongest scientific potential, has stagnated since 2017. Having in mind the well-known metaphor: "That science stands on the shoulders of giants" it can be assumed with high probability that the indicated trend will have a negative impact on the development and advancement of science and research.

With the strengthening of geopolitical tensions, and especially with the straining relations on the issue of Taiwan and Hong Kong, these trends will continue, which will reduce the achievements of science and research. It turns out that the geopolitical relations between the great powers will directly affect the cooperation of science and the results of research, but also the time of arrival of new scientific information. /12/

It is noticeable that scientists and researchers felt more pressure during the pandemic to share and exchange knowledge and information, as well as the results of scientific research. It turned out that the legislation regarding the protection of

intellectual rights and property in the pandemic also showed its weaknesses in terms of keeping the results secret, in order to achieve a greater financial effect. The closure, or insufficient exchange of knowledge about the virus between scientists and researchers at the international level, has also led to less visibility of science centers and their experts, which has weakened international cooperation.

Related to the previous is the commitment of the scientific community to make huge individual, or institutional depots of knowledge that are stored, available to the scientific community and the general public, through the so-called "Open Science". The C-19 pandemic encouraged the development of the idea of open science, which would be "concretely implemented through a number of basic open science practices, such as: Open Access, Open Source, Open Data and Open Peer-Review, meaning that all scientific communication is free available with full reuse rights. An open approach would also include papers that have not been reviewed and that have not been published in scientific journals, but which contribute to the transparency of science development, although they may have certain errors and shortcomings. However, it should be borne in mind that there is no absolute inaccuracy in unpublished and unreviewed papers, but that scientific claims and laws in them, as in peer-reviewed papers, should be constantly checked and solutions sought that will have a higher degree of probability, or lower production costs, etc. The idea of open science stimulates scientific debate, which would benefit the subjects who manage the pandemic crisis in the fight against COVID-19 and the exchange of different ideas. (Munafò MR et al., 2017.)/13/

Experience from the C-19 pandemic shows that at the time of the COVID-19 pandemic, there was not even a nearly even distribution of research. Richer countries and science centers with larger research budgets were mainly engaged in scientific research. It turned out that during the pandemic, "most large international clinical trials were conducted by more developed countries, including the treatment of vaccines, which could be given in a hospital setting." This has prolonged, but also increased the costs of discovering vaccines, of tests and other antiviral drugs. The price listed in the number of infected or dead was paid by countries with low or medium income and development. If there had been greater international scientific cooperation, but also humanity, many problems in the fight against the C-19 virus would have been solved faster and more effectively.

A special challenge during the pandemic in scientific research was presented by women scientists, researchers and associates. Closing or reduced use of the potential of the institutions in which they worked, but also of other institutions such as schools, business organizations that switched to work from home, made it difficult to engage in science and research. The closure of kitchen and restaurant facilities has forced women scientists to do housework related to the normal functioning of the household

and family, such as helping children master distance learning programs, preparing food for family members, commitment to older family members and all that in small and small families. All this took place in unconditional premises, away from laboratories and other advanced technologies that exist in scientific research centers. In this regard, Vice President for Academic and Government Relations at Elsevier, Leslie Thompson, states: "At the individual level, women face special challenges as members of collaboration; the representation of women in scientific publications in 2020 has shown that women have fewer number of papers, compared to men, and at the same time they have a smaller network of international collaborators."/14/

In the crisis of the COVID-19 pandemic, the difference between male and female researchers has noticeably increased. This difference existed before, but COVID-19 made this situation even worse. Women, scientists and researchers, in the pandemic have lost their primary authorial role and appear deeper on the list of authors. The situation is the same when it comes to databases where studies and research results are registered. One of the reasons for this situation, which was discussed, is that women took over a large part of the responsibilities of families and households at the expense of scientific research, due to the closure of schools, kindergartens, etc. (Myers, Kr et al., 2020.)/15/

RESUME

The management of the pandemic crisis has been inconsistent since its inception; in many elements it was unclear and contrary to scientific and logical conclusions. Although crisis management belongs to managerial organizational sciences, this work has been wrongly handled by medical professionals who are not trained in crisis management. Thus, the world on a global level came to the situation that the pandemic is managed by medical experts through the institute of crisis staffs, who during medical education had almost no subject from organization, management, crisis management, operational research, system theory, chaos theory, etc. These crisis headquarters in transition and underdeveloped countries were more likely to represent experts who were supposed to "cover" the decisions of politicians, who often dominated crisis headquarters and who thought more about the rating of their political options than about the health of the population.

The public health systems of a large number of countries were not prepared for the pandemic. The reasons for this should be sought in the indisputable fact that pandemics are occasional and temporary and are understood as not to occur in the near future, but also that expenditures for the preparation of something that will occur in the future are irrational and that these funds should be redirected to other activities. There is no need to explain how wrong this is, because it turns out that the damage from the C-19 pandemic was far greater than if investments had been made

for years in infrastructure, technology, but also in human resources that would protect the population from infection and that would treat the infected. Even when these capacities are not used, they are the most cost-effective, like firefighters who are most useful when they do not have a job, ie if they do not work.

Previous analysis has shown and proven that science, and especially medical science, has not adequately responded to the challenges imposed by the COVID-19 pandemic. These problems more or less existed before the pandemic, but some gained a new dimension and visibility. Many practical applications of science were denied or marginalized, ie there was no clear scientific (non) medical information about their application in the fight against the pandemic. Medical science, which is based on provable or factual medicine, showed its opposite in the pandemic, so that the medical profession was so divided that even medical experts did not believe in a cure for the virus, which is evident in the rejection of the vaccine as an achievement made by the medical-pharmaceutical sciences. Thus, civilization has come to a situation where those who are in charge of protecting and treating the infected, that is, applying proven methods of treatment, do not use vaccines or other medical means themselves. This has called into question confidence in medicine. It further leaves serious consequences for medicine, but also for other sciences, ie for the future of civilization, because trust in medical science and profession is one of the most important aspects in all spheres of life and work.

This paper also points out the insufficient understanding of science by the population, but also by the medical profession. Science and the laws it has discovered are not absolutely true, but they remain at the level of probability. This further means that the world is probably governed by the laws established by science. The medical profession has not used this fact enough in explaining the success of medicine and vaccines, because individual cases that appear as a by-product in their use belong to the group of deviations from the established scientific laws. It is certain that this fact would be useful for clarifying individual cases and deviations from what science has established, especially if such explanations would involve public communication experts, instead of political structures.

In parallel with the above, it is necessary to understand the complexity of the fight against the pandemic, and that this problem cannot be solved only by the medical profession, but that multidisciplinary teams from different fields must participate in it. The idea of Open science is one of the possible solutions, because it has been proven that people in crisis situations are ready to integrate, cooperate, in order to eliminate or reduce the danger to human health and lives.

REFERENCES:

1. Ewen Callaway, Heidi Ledford, Giuliana Viglione, Traci Watson and Aleksandra Witze: "COVID i 2020: An extraordinary year for science, *Nature*, 14. Decembre, 2020.
2. Brendan Maher and Richard Van Noorden: "How will Covid-19 reshape science, technology and innovation", *OECD*, 22. juni 2021.
3. Venkat Narayan i drugi: The COVID-19 Pandemic as an Opportunity to Ensure a More Successful Future for Science and Public Health, *JAMA*, (6) Januar, 2021.
4. Vojislav Vucenovic i drugi: *Holisticka teorija organizacije*, FORKUP, Novi Sad, 2011. str. 234.).
5. Vojislav Vucenovic i Bozidar Lekovic: *Menadžment-Filozofija i tehnologija*, Zelnid, Beograd, 1998. str. 37.).
6. Zivota Radosavljevic i drugi: "Samo-Organizacija", FORKUP. Novi Sad, 2011. str. 153-165.
7. Au L, da Silva RGL: Globalizing the scientific bandwagon: trajectories of precision medicine in China and Brazil, *SciTechnol Hum Vrednosti*, 2021. <https://doi.org/10.1177/0162243920930282>.
8. Suzana Pajic, Zivota Radosavljevic, Aleksandar Andjelkovic: "Definisanje i razgranicenje pojmova", u *Upravljanje pandemijom CORONE-19 - Nemedicinski pristup, monografija, Fakulteta poslovne studije i pravo*, Beograd, 2020. str. 24.).
9. Webb Hooper M, Napoles AM, Perez-Atable EJ: "COVID-19 and racial/ethnic disparities", *JAMA*, 2020, 323 (24): 2467.).
10. How will Covid-19 reshape science, technology and innovation, *OECD*, 22. juni 2021.
11. Matt Apuzzo and David D. Kirkpatrick: "Covid-19 Changed How the World Does Science, Together", www.nytimes.com.translate.goog/2020/04/01/world/europe/coronavirus-science-research-cooperation.html?), pristupljeno 30.07.2021.
12. Research collaborations bring big rewards: the world needs more", *Nature* 594, 2021, pp.301-302.).
13. Munafo MR i drugi: "A manifesto for reproducible science", *Nat Hum Behav*, 2017. pp. 1-9.).
14. *Gender in the Global Research Landscape* (Elsevier, 2020.).
15. Myers, Kretal, "Nature Hum Behav, 4 2020. pp. 880-883