doi: https://doi.org/10.33763/finukr2020.12.059

УДК 001.89:330

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SOME ASPECTS OF THE DEVELOPMENT OF RESEARCH IN THE WORLD AND IN UKRAINE IN THE CONTEXT OF THE IMPACT OF THE COVID-19 PANDEMIC

Abstract. The article considers the state of scientific activity in foreign countries and in Ukraine in the context of the impact of the David-19 pandemic. The study focuses on the Global R&D Financing Forecast, the IMF's science-intensive forecast, the OECD's Review of Why Open Science Is Necessary to Combat COVID-19, and more. A quantitative assessment of the financial support of the scientific sphere of Ukraine and other countries of the world is given. It is estimated that expenditures on science in Ukraine in 2019 amounted to 0.43% of GDP, ie there is no budget funding for research in the amount of at least 1.7% of GDP. Emphasis is placed on the draft State Budget of Ukraine for 2021, which takes into account R&D expenditures in the amount of UAH 11,835.4 million, of which UAH 9072.5 million from the general fund of the state budget. and taking into account the gradual increase in expenditures to support the activities of the NFD, whose scientific council in 2020 approved the ranking lists of projects participating in the competitions "Science for Human Security and Society", where the vast majority of research focuses on the current COVID-19 epidemic. The study found that the COVID-19 pandemic had significant negative effects on R&D, depending on industry and technology. And due to falling incomes, the level of research funding has also decreased. Current experience of measures to combat the spread of coronavirus in developed countries shows that the greatest effectiveness is achieved due to a combination of strict and very strict anti-epidemiological measures and the urgent increase and expansion of funding for this medical field, including through redistribution of budgets, approval of new funding programs including at the expense of internal and attraction of external resources.

Keywords: COVID-19, research activity, efficiency, science-intensity of GDP, budgetary financing of scientific research, competition of NFD "Science for safety of the person and society".

JEL classification: I20, I21, I23.

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ОКРЕМІ АСПЕКТИ РОЗВИТКУ НАУКОВО-ДОСЛІДНОЇ ДІЯЛЬНОСТІ В СВІТІ ТА В УКРАЇНІ В КОНТЕКСТІ ВПЛИВУ ПАНДЕМІЇ COVID-19

Анотація. У статті розглянуто стан наукової діяльності за кордоном та в Україні в контексті впливу пандемії COVID-19. Акцентовано увагу на Глобальному прогнозі фінансування НДДКР, прогнозних розрахунках МВФ щодо наукоємності, відповідному огляді ОЕСР та ін. Наведено кількісну оцінку фінансового забезпечення наукової сфери України та державах світу. Встановлено, що витрати на науку в нашій країні (у 2019 р. – 0,43 %) не забезпечують бюджетного фінансування наукової діяльності у розмірі не менше 1,7 % ВВП. Розглянуто видатки на наукову і науково-технічну діяльність у проекті Державного бюджету України на 2021 р., у якому передбачено поетапне їх збільшення для забезпечення діяльності Національного фонду досліджень України. Науковою радою останнього у 2020 р. затверджено рейтингові списки проектів – учасників конкурсів "Наука для безпеки людини та суспільства", причому в переважній кількості з них зроблено акцент на дослідженнях в умовах пандемії.

Ключові слова: COVID-19, наукова діяльність, результативність, наукоємність ВВП, бюджетне фінансування наукових досліджень, конкурс НФДУ "Наука для безпеки людини та суспільства".

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ОТДЕЛЬНЫЕ АСПЕКТЫ РАЗВИТИЯ НАУЧНО-ИССЛЕДОВАТЕЛЬСКОЙ ДЕЯТЕЛЬНОСТИ В МИРЕ И В УКРАИНЕ В КОНТЕКСТЕ ВЛИЯНИЯ ПАНДЕМИИ COVID-19

Аннотация. В статье рассмотрено состояние научной деятельности за рубежом и в Украине в контексте влияния пандемии COVID-19. Акцентировано внимание на Глобальном прогнозе финансирования НИОКР, прогнозных расчетах МВФ по наукоемкости, соответствующем обзоре ОЭСР и др. Приведена количественная оценка финансового обеспечения научной сферы Украины и странах мира. Установлено, что расходы на науку в нашей стране (в 2019 г. – 0,43 %) не обеспечивают бюджетного финансирования научной деятельности в размере не менее 1,7 % ВВП. Рассмотрены расходы на научную и научно-техническую деятельность в проекте Государственного бюджета Украины на 2021 г., в котором предусмотрено поэтапное их увеличение для обеспечения деятельности Национального фонда исследований Украины. Научным советом последнего в 2020 г. утверждены рейтинговые списки проектов – участников конкурсов "Наука для безопасности человека и об-

щества", причем в подавляющем числе из них сделан акцент на исследованиях в условиях пандемии.

Ключевые слова: COVID-19, научная деятельность, результативность, наукоемкость ВВП, бюджетное финансирование научных исследований, конкурс НФДУ "Наука для безопасности человека и общества".

In modern realities, the issue of enhancing research capacity to ensure the state security in accordance with modern challenges and threats to national security, which must be addressed in such difficult times as the COVID-19 pandemic, is extremely important. Improving the quality and efficiency of the research sector in the field of creating new knowledge as the basis of an innovative economy will help solve this problem for countries.

Carrying out systematic monitoring of scientific and scientific-technical activities in the context of counteracting the COVID-19 pandemic, in turn, will assess the current state and effectiveness of the R&D sector to determine future development prospects. After all, achieving the right balance in research funding can be the basis for the formation of a long-term strategy for innovative economic development, and its implementation could ensure a high level of socio-economic development of the state.

The issues of research activity evaluation are studied by a wide range of Ukrainian specialists who have made a significant contribution to the development of the outlined topic. In particular, some fundamental provisions for evaluating the effectiveness and efficiency of scientific research have been proposed by such scientists as: S. Gasanov, N. Hnatyuk, O. Danilchenko, T. Iefymenko, I. Melnyk, B Oleksiuk, O. Kaminska, K. Pavliuk, L. Lisovska, A. Hnap, N. Kraus, I. Bohdan, A. Sviridovska and others [1–10].

We also note researchers who have made a significant scientific contribution to the study of scientific development in a pandemic, in particular scientists from such scientific institutions as the Institute of Molecular Biology and Genetics of the National Academy of Sciences of Ukraine, National Science Center "Kharkov Institute of Physics and Technology"; Director of the M. Ptukha Institute of Demography and Social Research of the National Academy of Sciences of Ukraine, Academician of the National Academy of Sciences of Ukraine E. Libanova; Director of the State Institution "Institute of Economics and Forecasting of the NAS of Ukraine" Academician of the NAS of Ukraine V. Geets [11]; specialists of the State Institution "Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine" who provide constant monitoring, analysis and forecasting of the spread of the COVID-19 epidemic in Ukraine, etc. [11].

However, despite the significant achievements of these scientists and practitioners, this issue in terms of studying the state of research activity in foreign countries and in Ukraine in the context of the Covid-19 pandemic is insufficiently covered, which determines the relevance of the proposed study in modern realities. Studying practices of other countries on development of research activity, the systematization of scientific achievements of Ukraine concerning influence and consequences of Covid-19, can become the factor of

restoration of economic growth, promote increase of intellectual potential, social and economic development.

In view of this, we believe that the issue of assessing the state of development of research activity in Ukraine and other countries in the context of the impact of the Covid-19 pandemic is relevant and important for the research and subject analysis.

The purpose of the article is to study the state of development of research activity in foreign countries and in Ukraine in the context of the impact of the Covid-19 pandemic.

A special update of the annual edition of the Global R&D Funding Forecast in 2020 was devoted to the analysis of the consequences of the impact of the COVID-19 pandemic in 2020 [12–13]. The need to update the Global Forecast is due to the fact that GFF for 2020 was published in the issue of R&D World in February 2020 [14], before the effects of an outbreak of a new coronavirus disease (COVID-19) became apparent.

Therefore, the Special Forecast of the Global Forecast issued in August 2020 summarizes the data collected before July 15, 2020 and reflects the results and consequences that the COVID-19 pandemic had on a global scale over a 6-month period. The COVID-19 pandemic has had different consequences for R&D, depending on industry and technology. Relatively few areas have not changed. The sphere of air transportation, restaurant and entertainment business, and the sphere of retail trade were particularly affected. And as a result of falling incomes, the level of research activity also decreased.

The reductions in R&D were mostly not as significant as the general economic downturns, as R&D managers acknowledge that R&D is their main activity aimed at the future growth of their institutions. However, the COVID-19 pandemic had a negative impact on R&D funding. As the amount of R&D decreased, R&D funding decreased.

Let's consider the long-term consequences of research and development in the field of combating COVID-19. Today, international research is focused on the active development of potential countermeasures and treatments for COVID-19. Researchers use three different approaches: 1) changing existing drugs; 2) Invention and development of antibodies to COVID-19 and 3) Development and testing of vaccines against COVID-19. A recent report by the Association of Pharmaceutical Research Manufacturers (PhRMA) shows that more than 400 drugs and vaccines are in clinical development for the treatment or prevention of bacterial and viral infections that cause infectious diseases, including COVID-19.

Next, let's analyze the global amount of R&D funding (adjusted for the effects of COVID-19). Thus, as of July 15, 2020, gross domestic expenditure on R&D in Asia amounted to 45.0% of global volume or $ 1026.6 billion, in North America 26.9% or $ 613.0 billion, and in the United States 24.9% or $ 568.1 billion (Table 1).

Taking into account the double-digit unemployment rate, 26 million officially unemployed and the closure of production, the United States officially entered a recession in July 2020, after two consecutive quarters of GDP decline of 4.8%. This interrupted the longest peak of economic expansion in the United States –

Table 1. **Global R&D funding (adjusted for COVID-19 effects)**

Region, country	2019		2020 (01/01/2020)		2020 (07/15/2020)	
	GERD*, billion USD	R&D, %	GERD, billion USD	R&D, %	GERD, billion USD	R&D, %
All countries	2,370.8	100.0	2,434.3	100.0	2,280.2	100.0
Top 10 countries	1,857.5	78.3	1,909.8	78.5	1,795.1	78.7
North America	644.5	27.2	658.4	27.0	613.0	26.9
USA	596.6	25.2	609.7	25.0	568.1	24.9
South America	51.8	2.2	52.6	2.2	47.8	2.1
Europe	492.0	20.8	499.7	20.5	458.0	20.1
Africa	20.6	0.9	21.2	0.9	19.8	0.9
Middle East	56.3	2.4	57.9	2.4	54.2	2.4
Russia/CIS	64.5	2.7	65.8	2.7	60.8	2.7
Asia	1,041.1	43.9	1,078.8	44.3	1,026.6	45.0
China	532.8	22.5	563.7	23.2	538.1	23.6

* Gross domestic expenditure on R&D.

Source: Heney, P. (2020, August 19). *Global R&D Funding Forecast: Special mid-year update*, 1. Retrieved from https://www.rdworldonline.com/global-rd-funding-forecast-special-mid-year-update-part-1/.

for almost 128 consecutive months, which began in June 2009. Before the COVID-19 pandemic, the unemployment rate in the United States during 2010 to 2019 was steadily declining. But this record was rapidly leveled during only one four-week period in April 2020.

In a recent report prepared by the US Congressional Budget Office (CBO) (Interim Economic Forecasts for 2020 and 2021) states that the US economy is expected to recover in the second half of 2020, as concerns about the COVID-19 pandemic will diminish and local governments will ease living conditions, ban public gatherings and other activities [15].

And although the CBO does not expect any major changes in the unemployment rate in 2020, it is expected to fall to about 9.3% in 2021, with the number of unemployed by the end of 2020 being more than 10 million people. Although the CBO expects a significant improvement in economic conditions by the 4th quarter of 2021, inflation-adjusted industrial output is still expected to be about 1.6% lower than in the 4th quarter of 2019. By the 3rd quarter of 2020, the number of employees is expected to increase and job losses will fall significantly, according to the CBO report, as the degree of social distancing decreases. However, income levels in the second half of 2020 do not compensate for losses incurred at the beginning of the year. At the end of the 4th quarter of 2021, real US GDP is still expected to be 1.6% lower than at the end of the 4th quarter of 2019.

In March and April 2020, four laws were enacted that will directly enhance assistance to families, businesses, and state and local governments affected by COVID-19. These laws also in some ways provided funding for research conducted by researchers at the expense of federal government resources in various research laboratories. These laws included:

– Coronavirus Preparedness and Response Supplemental Appropriations Act;
– The Families First Coronavirus Response Act;

– The Coronavirus Aid, Relief, and Economic Security (CARES);
– Paycheck Protection Program and Health Care Enhancement Act.

The CARES Act provides $3.5 billion to The Biomedical Advanced Research and Development Authority (BARDA), within the U.S. Department of Health and Human Services for the production and purchase of vaccines, therapy, diagnostics of active pharmaceutical ingredients. These funds can also be used to build a new generation of production facilities in the United States that are not currently owned by the US government. BARDA can also partner with private sector companies in research and development. BARDA will invest in a number of medical countermeasures to diagnose, treat or protect against COVID-19.

Another $945 million is provided to the National Institutes of Health (NIH) to respond to COVID-19; and $1 billion is allocated to the US Centers for Disease Control and Prevention (CDC) for expanded global disease detection and response.

These laws will increase the federal budget deficit by 2.2 trillion. dollars, and in 2021 by 0.6 trillion. These amounts account for 11% of US GDP in 2020 and 3% of GDP in 2021, and add to the current US public debt (which before the adoption of these laws amounted to more than 20 trillion dollars). Similar laws exist and are adopted in Europe to financially support the economies of countries. The CBO estimated that the US budget deficit exceeded 3 trillion. dollars for 12 months, until June 2020, as incentive spending increased and tax revenues fell, creating the largest annual deficit since World War II.

The CBO expects Real business fixed investment (BFI), which includes the acquisition of new equipment, structures and intellectual property products, including software, to decrease by approximately 15.8% in 2020, as demand for these goods and services decreases. Restricting activities in the context of preventing the spread of COVID-19 will reduce the supply of new financial investment available to businesses. The CBO expects lower equipment and design costs to reduce real BFIs by an average of 3.7% in the second half of 2020. At the same time, the CBO forecasts that the BFI will grow by 13.4% in 2021, but will still be about 4.5% lower than in the 4th quarter of 2019.

Table 2 shows the correction of changes in gross domestic expenditure on R&D (GERD) due to the spread of the COVID-19 pandemic, and it is as follows: in North America, the change in GERD for 2019/2020 amounted to $31.5 billion (4.90%), in the USA – 28.5 billion dollars (4.80%) and in Europe – $34.05 billion (6.90%).

It is worth noting the opinion of Dr. Anthony Fauci, named 40th scientist of the year in 2005 by R&D Magazine (formerly R&D World). As director of the National Institute of Allergy and Infectious Diseases (NIAID), Dr. Fauci is a leading US technical expert on COVID-19 and a member of the White House Coronavirus Working Group. He firmly believes in the effectiveness of some vaccines, which are currently undergoing phase III clinical trials and can be completed by the end of 2020. If the trials are successful, the US government may make these vaccines available by the end of 2021.

The forecast made at the meeting of the Federal Open Market Committee on June 10, 2020 predicted that the US GDP growth will decline by 6.5% in 2020, but

Table 2. **Global R&D funding relative to GDP (adjusted for COVID-19 effects)**

Region, country	2019		2020 Original Forecast		2020 Update		Change 2020/2019	
	GDP, billion USD	GERD, billion USD	GDP, billion USD	GERD, billion USD	GDP, billion USD	GERD, billion USD	GERD 2019-2020, %	GERD 2019-2020, billion USD
All countries	137,773.6	2,370.8	141,655.8	2,434.3	132,498.6	2,280.2	–3.82	–90.6
Top 10 countries	84,730.4	1,857.5	87,174.7	1,909.8	81,798.9	1,795.1	–3.35	–62.4
North America	26,259.1	644.5	26,809.8	658.4	24,636.8	613.0	–4.90	–31.5
USA	21,006.4	596.6	21,468.1	609.7	19,725.0	568.1	–4.80	–28.5
South America	6,831.7	51.8	6,931.2	52.6	6,362.1	47.9	–7.64	–3.9
Europe	26,755.4	492.0	27,220.7	499.7	24,931.0	458.0	–6.90	–34.0
Africa	4,865.2	20.6	5,008.1	21.2	4,699.1	19.8	–3.83	–0.8
Middle East	7,599.2	56.3	7,811.8	579	7,363.9	54.2	–3.87	–2.1
Russia	5,171.3	64.5	5,295.4	65.8	4,915.0	60.8	–5.77	–3.7
Asia	60,291.7	1,041.1	62,578.8	1,078.8	59,581.7	1,026.6	–1.39	–14.5
China	26,909.1	532.8	28,469.8	563.7	27,178.2	538.1	1.00	5.3

Source: Heney, P. (2020, August 19). *Global R&D Funding Forecast: Special mid-year update*, 1. Retrieved from https://www.rdworldonline.com/global-rd-funding-forecast-special-mid-year-update-part-1/.

will increase to 5% in 2021 and 3.5% in 2022. As R&D expenditures are closely linked to the GDP growth, this means that R&D investment may decline in 2020, and will resume similarly in 2021-2022. This requires the successful implementation of the COVID-19 vaccine and the lack of any mutation against COVID-19.

Of course, the COVID-19 pandemic is a global event, and the world economy is also in recession. It is expected that even the traditionally high growth of the Chinese economy will slow down from 6.1% GDP growth in 2019 to only 1.2% in 2020. Only in India is expected the economic growth in 2020 by only 1.9%, compared to 4.2% in 2019. The International Monetary Fund (IMF) expects the COVID-19 pandemic to affect all economies, with the largest economies having a GDP decline of –5% to –6.1%.

The IMF expects the effects of the COVID-19 pandemic to diminish in 2021, and thus most economies are projected to return to higher GDP growth rates (3% to 8%) than moderate GDP growth (2% to 5%), which was observed in 2019.

East Asia and the Pacific are projected to grow by only 0.5%. South Asia will shrink by 2.7%, sub-Saharan Africa will also grow by 2.8% and the Middle East and North Africa will shrink by 4.2%. Europe and Central Asia are projected to decline by 4.7% and Latin America by 7.2%. These recessions will nullify years of progress toward development goals and return tens of millions of people to extreme poverty.

These countries will be under pressure from weak health care systems, reduced trade and tourism, reduced remittances, reduced capital flows and increased financial conditions, which will increase debt. Exporters of oil, gas or manufactured goods will be particularly vulnerable to declining demand and falling oil prices. Food supplies are expected to be sufficient, but food security issues may be at stake, especially in changing climates. All these weaknesses pose a strong threat to R&D investment due to their weak economy.

In late May 2020, a bipartisan group of four U.S. lawmakers filed the Endless Frontier Act, a bill that proposes to allocate more than $100 billion over the next five years to new U.S. technology efforts at the U.S. National Science Foundation.

The bill provides for the transformation of the National Science Foundation (NSF) into the National Science and Technology Fund (NSTF), which will receive new funding mechanisms that differ from existing NSF research programs. The new Foundation will fund new university centers, test benches, fellowships and technology consortia with a proposed annual budget of $35 billion over four years. This far exceeds NSF's current annual budget of $8.3 billion. The Department of Commerce will also receive a new multibillion-dollar technology center program to build R&D partnerships over the next four years in areas that are not yet leading innovation centers.

The drafters of the bill believe that it meets the technological and economic challenges posed by China and other countries and the COVID-19 pandemic. It is one of several bills to be considered by Congress and offers a significant increase in US federal support for science and technology. The bill proposes a primary set of 10 areas focused on technology: Artificial intelligence and machine learning; High performance computing, semiconductors and advanced computer hardware; Quantum computing and information systems; Robotics, automation and

Table 3. **Gross domestic product and R&D expenditures**

Country	2018			2019			2020 (01/01/2020)			2020 (07/15/2020)		
	GDP, billion USD	R&D, % GDP	GERD, billion USD	GDP, billion USD	R&D, % GDP	GERD, billion USD	GDP, billion USD	R&D, % GDP	GERD, billion USD	GDP, billion USD	R&D, % GDP	GERD, billion USD
USA	20,494.0	2.84	565.76	21,006.4	2.84	596.58	21,468.1	2.84	609.69	19,775.0	2.88	568.10
China	25,362.0	1.97	499.63	26,909.1	1.98	532.80	28,469.8	1.98	563.70	27,178.2	1.98	538.12
Japan	5,414.7	3.50	189.51	5,447.2	3.50	190.65	5,458.1	3.50	191.03	5,163.9	3.50	179.79
Germany	4,456.1	2.84	126.55	4,518.5	2.84	128.32	4,577.2	2.84	130.00	4,202.2	2.84	119.34
India	10,498.0	0.85	89.23	11,138.4	0.86	95.79	11,216.4	0.86	96.46	10,782.0	0.86	92.73
North Korea	2,071.0	4.32	89.47	2,075.1	4.35	90.27	2,120.8	4.35	92.25	2,050.2	4.35	89.18
France	3,037.0	2.25	68.33	3,070.4	2.25	69.08	3,110.3	2.25	69.98	2,849.3	2.25	64.11
Russia	4,051.0	1.52	61.58	4,095.6	1.50	61.43	4,173.4	1.50	62.60	3,849.9	1.50	57.75
United Kingdom	3,025.0	1.72	52.03	3,073.4	1.73	53.17	3,116.2	1.73	53.91	2,873.6	1.73	49.71
Brazil	3,366.0	1.17	39.38	3,396.3	1.16	39.40	3,464.2	1.16	40.18	3,124.6	1.16	36.25
Total	81,774.8	x	1,781.47	84,730.4	x	1,857.49	87,174.7	x	1,909.80	81,798.9	x	1,795.08

Source: Heney, P. (2020, August 19). *Global R&D Funding Forecast: Special mid-year update*, 1. Retrieved from https://www.rdworldonline.com/global-rd-funding-forecast-special-mid-year-update-part-1/.

advanced manufacturing; Natural or anthropogenic disaster prevention; Advanced communications technology; Biotechnology, genomics and synthetic biology; Advanced energy technology; Cybersecurity, data storage and data management technologies; and Materials science, engineering and exploration relevant to the other focus areas.

At the same time, Canada will allocate more than 450 million Canadian dollars (about 333 million US dollars) to support research centers at universities, whose financial base has shrunk due to the COVID-19 pandemic. However, due to the pandemic, many laboratories have already closed or are threatened with imminent closure. These funds will allow research centers to retain staff during the period of forced closure. Universities and related research institutions affected by this pandemic are being assisted with the payment of salaries through grants from federal agencies. The allocated funds will be able to cover 75% of the salaries of research center staff for several months, regardless of whether the institution is working or not [16].

Investments in science become especially relevant in such periods as the global pandemic COVID-19. As today's world practice shows, effective combating of such threats is possible due to the high level of medical science, adequate funding and investment in relevant fields, the availability of significant domestic financial, economic and other reserves and tough, rapid organization and implementation of countermeasures at the state level.

In the context of the current situation, it should be noted that in one of the latest reviews of the Organization for Economic Cooperation and Development (OECD) dated April 20, 2020, the document "Why open science is critical to combat COVID-19" was published. The main theses of the document are as follows [17]:

- In global emergencies like the coronavirus (COVID-19) pandemic, open science policies can remove obstacles to the free flow of research data and ideas, and thus accelerate the pace of research critical to combating the disease.
- While global sharing and collaboration of research data has reached unprecedented levels, challenges remain. Trust in at least some of the data is relatively low, and outstanding issues include the lack of specific standards, co-ordination and interoperability, as well as data quality and interpretation.
- To strengthen the contribution of open science to the COVID-19 response, policy makers need to ensure adequate data governance models, interoperable standards, sustainable data sharing agreements involving public sector, private sector and civil society, incentives for researchers, sustainable infrastructures, human and institutional capabilities and mechanisms for access to data across borders.

On July 20, 2020, European leaders agreed to set up a $858 billion special fund to help rebuild European economies affected by the COVID-19 pandemic. Also on July 21, 2020, after a long and difficult summit lasting four days, EU leaders agreed on the next seven-year EU budget and the related recovery plan. The result of the negotiations is a restriction on funding for research, innovation and education.

Negotiations focused mainly on agreeing on the overall cost of economic recovery (Next Generation EU), allocating and managing loans and grants.

As a result, an agreement was adopted, where Horizon Europe earmarked 13.5 billion euros less than proposed by the European Commission. At the same time, 5 billion euros were reduced under the program in the MFF and 8.5 billion euros were withdrawn from the Next Generation EU. Total funding for Horizon Europe will be € 80.9 billion, and this is not expected to have a significant impact on Covid-19 and other pressing issues [18].

According to the statistics provided in the analytical report: "Scientific and technical activities in Ukraine in 2019", the science intensity of GDP (expenditures on R&D by all sources as a percentage of GDP) in 2019 was 0.43% [19].

According to 2018 data, the share of R&D expenditures in the GDP of the EU-28 countries averaged 2.12%. It was higher than the average in Sweden – 3.32%, Austria – 3.17%, Denmark – 3.03%, Germany – 3.13%, Finland – 2.75%, Belgium – 2.76%, France – 2.02%; smaller – in Northern Macedonia, Romania, Malta and Cyprus (from 0.36% to 0.57%) [20].

The Law of Ukraine "On Scientific and Technical Activity" establishes an ambitious indicator that the State provides budget funding for scientific and technical activities in the amount of not less than 1.7% of Ukraine's GDP. However, in practice such an indicator has never been implemented. Expenditures on science in Ukraine decreased from 0.75% in 2010 to 0.43% in 2019. (Figure 1).

Thus, the level of funding for science has become lower than in any other EU country. The share of expenditures on science decreases along with the reduction of budget funding for science. This means that the achievements of budget funding for science in previous years have not been able to maintain the science intensity of GDP, even at a stable level through private sector funding [21].

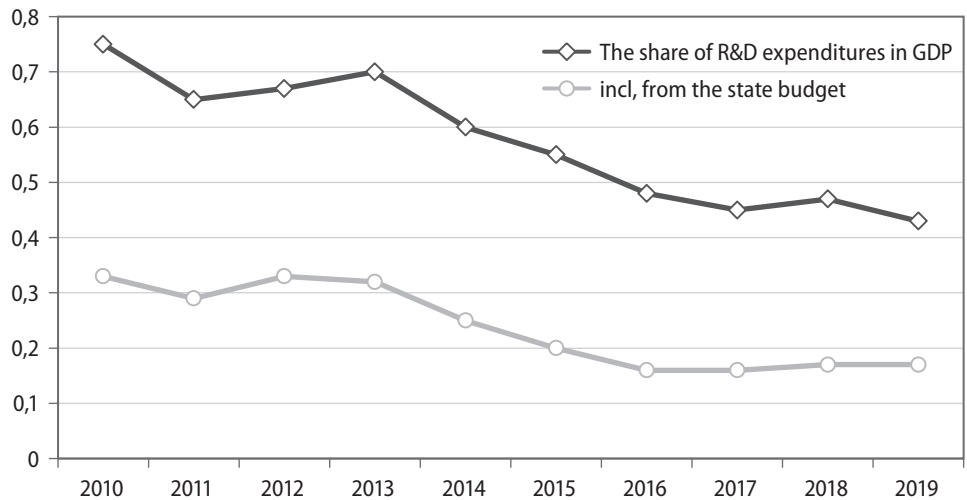

Figure 1. **Dynamics of science intensity of Ukrainian GDP, %**

Source: Pysarenko, T. V., Kuranda, T. K., Kochetkova, O. P., Havrys, T. V., & Osadcha, A. B. (2019). *Scientific and scientific-technical activity in Ukraine in 2019* (Scientific-analytical report). Kyiv: UkrINTEI. Retrieved from https://mon.gov.ua/storage/app/media/nauka/informatsiyno-analitychni/2020/08/13/nadnaukaza2019-stisnuto.pdf.

At the same time, the science intensity of GDP, as in previous years, remained critically low. In 2019, this figure was 0.43% (a record low for the last 10 years), and at the expense of the state budget –0.17%. For comparison: according to 2018, the science intensity of the GDP of the EU-28 averaged 2.12% [22].

The amount of expenditures for the implementation of R&D in Ukraine from all sources of funding in 2019 amounted to UAH 17,254.6 million, including from the state budget – UAH 6,603.9 million or 38.3%. In the structure of domestic customers' funds, the largest share was accounted for by funds of business sector organizations.

Budget financing remains one of the main financial instruments of scientific and technical policy of economically developed countries, the main form of direct state support for scientific and technological development. From the state budget, the scientific sphere was financed by 20 main spending units through 49 programs. UAH 9,312 million was financed within them, of which over 70% was from the general fund. Most of the general fund (over 80%) was spent on research and development as a whole. Another 7.6% went to support the development of scientific infrastructure and upgrade the material and technical base, and 12.2% – in other areas.

One of the most important indicators of the effectiveness of the use of budget funds to finance research and development is the level of implementation of scientific (scientific and technical) products. Thus, out of 19,453 units of products created at the expense of the state budget, almost 76% were implemented. However, the level of implementation of products created at the expense of the general fund is 70.6%, and created by the special fund – almost 90%. The same situation is observed for all types of products [22]. In Figure 2 you can see the dynamics of funding the scientific sphere, from the budgets of general and special funds.

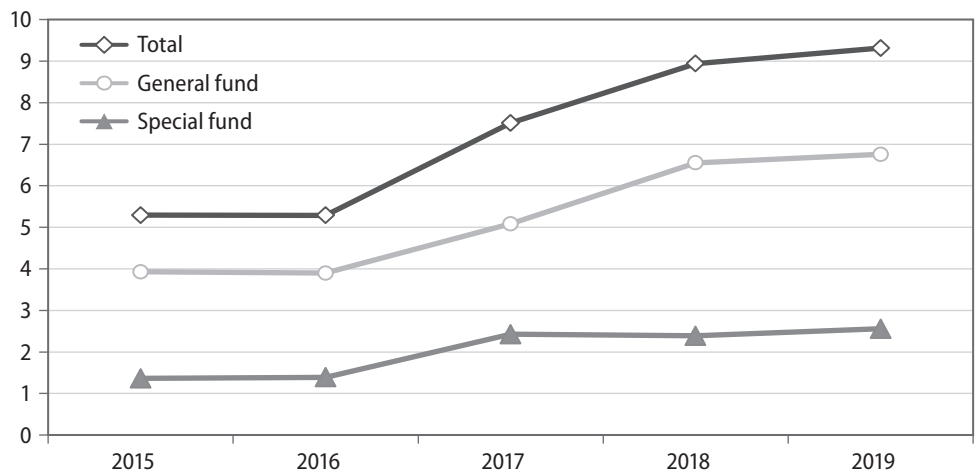

Figure 2. **Dynamics of budget financing of the scientific sphere, UAH billion**

Source: Pysarenko, T. V., Kuranda, T. K., Kochetkova, O. P., Havrys, T. V., & Osadcha, A. B. (2019). *Scientific and scientific-technical activity in Ukraine in 2019* (Scientific-analytical report). Kyiv: UkrINTEI. Retrieved from https://mon.gov.ua/storage/app/media/nauka/informatsiyno-analitychni/2020/08/13/nadnaukaza2019-stisnuto.pdf.

According to the directions of budgetary financing of scientific research, expenditures of the general fund in Ukraine are distributed as follows:

– in general, 80.16% (2018 – 79.31%) of the total expenditures of the general fund for the scientific sphere were directed to R&D, in particular: basic research – 49.84% (2018 – 49.35%), applied R&D – 29.20% (2018 – 26.97%), State target scientific and technical programs – 0.29% (2018 – 2.17%), R&D by government order – 0.63% (2018 – 0.64%), projects within the framework of international scientific and technical cooperation – 0.20% (2018 – 0.18%);

– financial support for the development of scientific infrastructure and renewal of material and technical base – 7.60% (2018 – 9.38%);

– for other areas of budget funding of the scientific sphere – 12.24% (2018 – 11.31%) (Figure 3).

In Ukraine, the total amount of R&D funding in 2019 amounted to UAH 7,761.48 million, of which 69.77% – from the general fund (Figure 4).

The largest shares of the general fund for R&D in 2019 were allocated for funding by the National Academy of Sciences (NAS) – 61.09% (2018 – 57.89%), the Ministry of Education and Science (MES) – 14.20% (2018 – 14.51%), the National Academy of Medical Sciences (NAMS) – 6.75% (2018 – 5.61%), the National Academy of Agrarian Sciences (NAAS) – 4.63% (2018 – 6.98%). The largest shares of the special fund for R&D accounted for the financing of applied R&D – 70.61% (2018 – 72.56%), of which the share of NAAS was 45.75%, NAS – 19.45%, MES – 18.36%, NAMS – 4.71%, and basic research – 29.38% (2018 – 27.28%), of which the share of NAS was 98.28%.

The structure of expenditures of the general fund for the implementation of R&D in the areas of budget financing is shown in Figure 5.

UAH 5,032.36 million was spent on R&D (in priority areas) (or 92.9% of the total expenditures of the general fund for the implementation of R&D). Of which

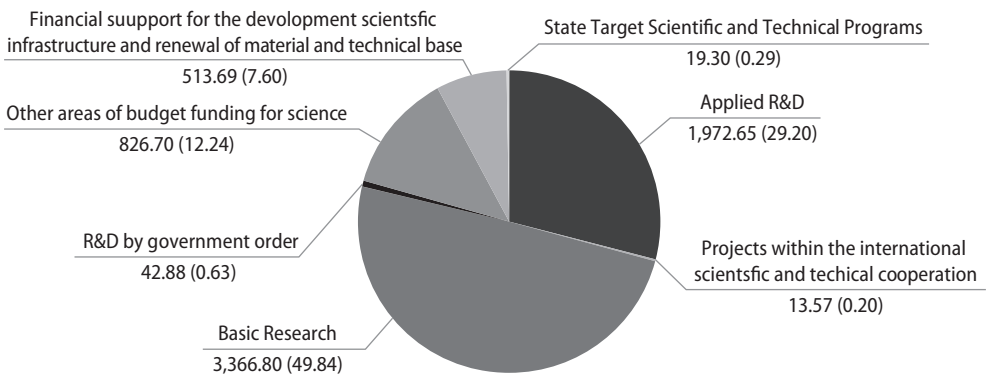

Figure 3. **Distribution of general fund expenditures for the scientific sphere by areas of budget financing, UAH million (%)**

Source: Pysarenko, T. V., Kuranda, T. K., Kochetkova, O. P., Havrys, T. V., & Osadcha, A. B. (2019). *Scientific and scientific-technical activity in Ukraine in 2019* (Scientific-analytical report). Kyiv: UkrINTEI. Retrieved from https://mon.gov.ua/storage/app/media/nauka/informatsiyno-analitychni/2020/08/13/nadnaukaza2019-stisnuto.pdf.

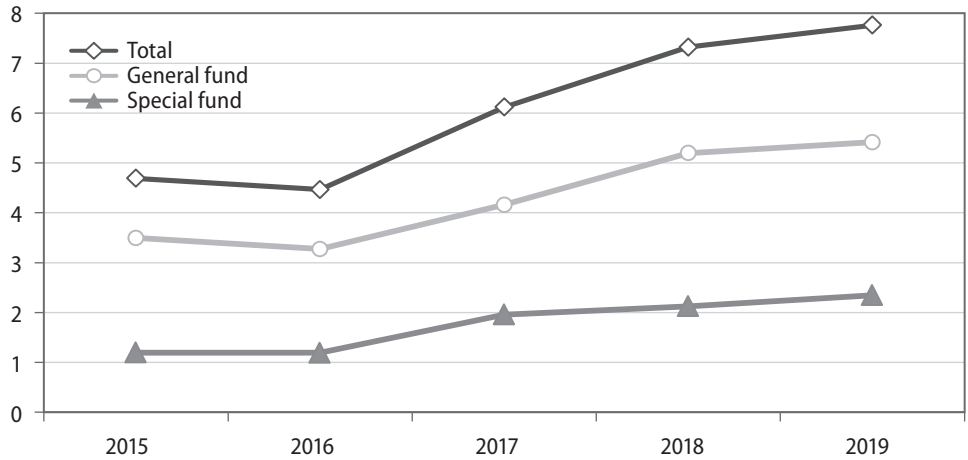

Figure 4. **Dynamics of budget financing of R&D, UAH million**

Source: Pysarenko, T. V., Kuranda, T. K., Kochetkova, O. P., Havrys, T. V., & Osadcha, A. B. (2019). *Scientific and scientific-technical activity in Ukraine in 2019* (Scientific-analytical report). Kyiv: UkrINTEI. Retrieved from https://mon.gov.ua/storage/app/media/nauka/informatsiyno-analitychni/2020/08/13/nadnaukaza2019-stisnuto.pdf.

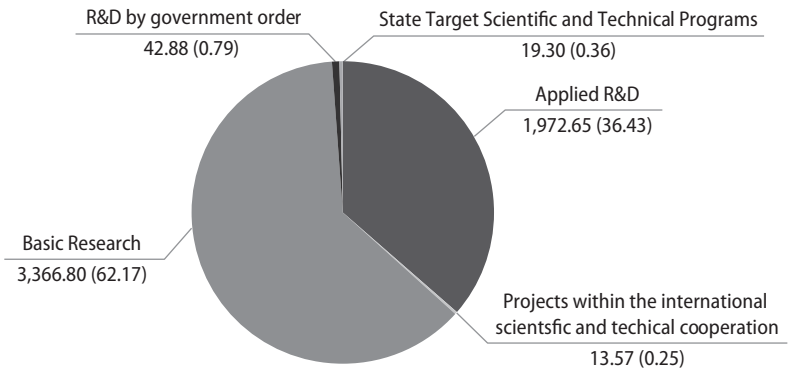

Figure 5. **Distribution of expenditures of the general fund for the implementation of R&D in the areas of budget financing, UAH million (%)**

Source: Pysarenko, T. V., Kuranda, T. K., Kochetkova, O. P., Havrys, T. V., & Osadcha, A. B. (2019). *Scientific and scientific-technical activity in Ukraine in 2019* (Scientific-analytical report). Kyiv: UkrINTEI. Retrieved from https://mon.gov.ua/storage/app/media/nauka/informatsiyno-analitychni/2020/08/13/nadnaukaza2019-stisnuto.pdf.

67.0% was spent on R & D in the priority area "Basic research on the most important issues of scientific and technical, socio-economic, socio-political, human potential to ensure Ukraine's competitiveness in the world and sustainable development of society and the state" (hereinafter – "Basic research").

The ratio of expenditures of the general fund for the implementation of R&D by type in 2019 compared to 2018 changed slightly in the direction of increasing the share of applied research and reducing the share of scientific and technical (experimental developments) (see Table 4).

Table 4. **Expenditures for R&D by types and sources of funding, UAH million**

Type of R&D	2018		2019	
	From all sources of funding*	General expenditures of the state budget**	From all sources of funding	General expenditures of the state budget
The cost of performing R&D, intotal, including by types of research	16,773.7	5,195.77	17,254.6	5,415.20
Basic research (B)	3,756.5	3,235.41	3,740.4	3,373.29
Applied research (A)	3,568.3	1,692.87	3,635.7	1,934.53
Scientific and technical (experimental) developments (S)	9,448.9	267.49	9,878.5	107.38
The ratio (B : A : S)	23 : 21 : 56	62 : 33 : 5	22 : 21 : 57	62 : 36 : 2

* According to the State Statistics Service.

** According to the main managers.

Source: Pysarenko, T. V., Kuranda, T. K., Kochetkova, O. P., Havrys, T. V., & Osadcha, A. B. (2019). *Scientific and scientific-technical activity in Ukraine in 2019* (Scientific-analytical report). Kyiv: UkrINTEI. Retrieved from https://mon.gov.ua/storage/app/media/nauka/informatsiyno-analitychni/2020/08/13/nadnaukaza2019-stisnuto.pdf.

Analysis of the expenditures of the general fund for the implementation of R&D in terms of science sectors shows that in 2019 (as in previous years) the largest amount of funds – UAH 4132.53 million (76.31% of the total expenditures of the general fund for R&D; 74.58% –2018) is aimed at the academic sector.

As for the peculiarities of science funding in Ukraine in a pandemic, different stakeholders have different views on ways to reform. In particular, it concerns the financing of the newly created National Research Fund of Ukraine (NRFU) and other issues of distribution of funds [23]. It should be noted that the first competitions of the Fund were announced in May 2020. Priorities were to address security issues, including COVID-19, and to support leading and young scientists. The relevant decision was made by the Scientific Council of the NRFU during an online meeting on April 27-30, 2020. The purpose of the competition "Science for Human Security and Society" is to support the best research projects to address pressing issues of human security and society in Ukraine.

In particular, in the areas of research related to: human and social biosafety; biomedicine; ecology; cyber and information security; responding to economic, social, humanitarian challenges in natural and man-made emergencies, including medical, biological, economic, social, psychological, humanitarian and cultural consequences of the COVID-19 pandemic and ways to overcome them. The total funding for the 2020 competition is UAH 100 million (about USD 3.7 million). There are two types of projects: with a deadline in 2020 and during 2020-2021. The maximum amount of project funding for one year – 5 million UAH [24].

It should be noted that the Scientific Council of NRFU approved the ranking lists of projects participating in the competitions "Science for Human Security and Society" and "support for research of leading and young scientists" [23], among which the vast majority of studies focus on research in the context of the COVID-19 pandemic.

Thus, it should be noted that the draft State Budget of Ukraine for 2021 takes into account expenditures on scientific and technical activities in the amount of 11,835.4 million UAH, of which, according to the general fund of the state budget – 9,072.5 million UAH. The gradual increase in expenditures to support the activities of the National Research Fund of Ukraine, which will provide grant support to research institutions, regardless of their departmental subordination, has been taken into account.

When planning the state budget expenditures for 2021, such an increase in expenditures is calculated taking into account the need to increase the share of grant support for research. In 2021, the limits of state budget expenditures to support the National Research Fund and provide grant support for research, which is part of the expenditures of the Ministry of Education and Science, are planned to be set at UAH 584 million, which is 6.4% of the total the amount of financial support for scientific activities from the general fund of the state budget.

In order to ensure priority research for the State by units of scientific institutions of the National Academy of Sciences, as well as to support research by research laboratories (groups) of young scientists of the National Academy of Sciences, the draft state budget includes expenditures of 479.2 million hryvnias.

Expenditures to support university science based on the results of competitive selection are included in the draft state budget for 2021 in the amount of UAH 820.5 million [25].

Ukraine will also join an open platform for the exchange of experience, including scientific information, on combating and overcoming the consequences of the COVID-19 pandemic, which will be established under the auspices of UNESCO. On March 30, 2020, under the auspices of UNESCO, a global scientific dialogue on COVID-19 was launched [26]. It is about uniting the efforts of scientists from all countries to overcome the coronavirus pandemic and its consequences on the principles of open science.

Thus, an open exchange of scientific data, initiatives and innovations in the field of personal protection, treatment, monitoring and forecasting of the spread of the virus will continue on the created single platform. The platform also has a unit for overcoming social and economic consequences, including the continuation of the educational process. Thus, we can conclude that in today's reality, decision-making to overcome the coronavirus pandemic is impossible without taking into account the professional expertise of the scientific community. This was especially emphasized today at the highest international level.

Today it is possible to analyze the available results that countries receive at the international level as a result of rapid implementation of state measures to combat the current pandemic, support for national medical systems, mainly providing appropriate additional urgent funding, legislative, organizational and legal support.

More than 30 companies around the world are working on the development of a potential vaccine against COVID-19, and are already actively testing on animals and volunteers. France and the United States have been developing coronavirus vaccines since February. In particular, the French biopharmaceutical

company Sanofi together with the US Department of Health plan to be ready for human testing in a year or at most 18 months.

The Kaiser Permanente Washington Health Research Institute in Seattle is funded by the US National Institutes of Health. They will be attended by 45 volunteers aged 18 to 55 years. The vaccine was developed by biotechnology company Moderna in collaboration with the US National Institutes of Health. And in April, the American company Inovio Pharmaceuticals began testing at the University of Pennsylvania and a test center in Kansas City.

Scientists at Imperial College London have also been actively testing COVID-19 vaccines on animals in recent months, and are now actively beginning experiments on volunteers. Vaccine development in Germany is mainly carried out by the biopharmaceutical company CureVac in Tübingentogether with the Paul Ehrlich Institute for Vaccines and Biomedical Medicines. Currently, its experts are tirelessly trying to find a counter to the new coronavirus.

China has reportedly developed eight coronavirus vaccines. According to the Institute of Laboratory Animal Research at the Chinese Academy of Medical Sciences, tests are performed on transgenic mice and macaques, and possible side effects of the drugs and their safety are assessed. In addition, Chinese doctors are rescuing citizens by transfusing the infected blood plasma of those who are recovering.

Polish specialists, who have already announced some success, are also working on the development of the vaccine. In particular, a group of researchers at Wroclaw Polytechnic was able to isolate from SARS-CoV-2 the enzyme responsible for its viability. Polish scientists have decided not to patent their invention, and provided the results of the study to scientists and pharmaceutical companies from around the world free of charge.

Instead, a team of Canadian researchers was able to isolate the SARS-CoV-2 virus, which is responsible for an outbreak in the world of severe acute respiratory syndrome, in the laboratory. The isolated virus will help researchers and develop better diagnostic tools, treatments and vaccines, as well as a better understanding of the biological structure, evolution and clinical properties of the SARS-CoV-2 virus.

Israel, unlike world leaders in biotechnology, is not looking for a new vaccine, but is trying to use an already created one – against avian coronavirus. Antigens created by the laboratory of the Miguel Research Institute in Galilee can not only cause a general immune response, but also stimulate the production of antibodies at the site of infection.

Instead, the progress of the pandemic, the number of deaths, and the extent of the infection are forcing practitioners to seek additional effective treatments, prevention, and side effects. There is currently no cure for the coronavirus Sars-CoV-2 or vaccines, but the drug, commonly used to treat rheumatoid arthritis and treat malignancies, has been shown to be effective in treating severe pneumonia caused by the Covid-19 virus, according to Italian scientists.

Trials of Tocilizumab have already taken place in several medical facilities in Italy. Today in Italy, individual patients have already begun to be treated with this

drug. The results prompted doctors to use the drug to treat people with coronavirus. Italian doctors are currently studying the possibility of large-scale experiments on the use of "Tocilizumab" as a drug from Covid-19.

But clinical studies of chloroquine, an antimalarial drug, implemented in one of the hospitals in Marseille, showed the effectiveness of its use in the treatment of coronavirus infection. Chloroquine has been used to treat malaria for over 70 years. In addition, earlier in February, French scientists have already referred to the positive results of the drug in ten Chinese hospitals, including Wuhan.

According to a Chinese study, antimalarial drugs have been shown to be relatively effective in curbing the development of pneumonia, improving lung condition and reducing the duration of the disease. However, a number of French experts have called for caution due to the lack of more in-depth studies and the presence of side effects that can be extremely serious, especially in the event of an overdose.

At the same time, scientists from the Biotechnology Center of the Jagiellonian University in Krakow, in collaboration with SEnsDx, have also taken some steps to combat the coronavirus, in particular in the context of developing rapid tests to detect it. They isolated proteins characteristic of the CoV-2 virus, which allows its rapid diagnosis. Scientists hope that the development of these rapid tests to detect coronavirus will allow them to be used outside laboratories – at stations, airports and more. All activities and developments are usually financed from national and joint budgets, including European budgets. Voluntary international sponsorship is also widely used to combat coronavirus.

Turning to the research of domestic scientists, it should be noted that scientists of the National Academy of Sciences of Ukraine joined in developing measures to combat the spread of COVID-19, preparing proposals to minimize its consequences for public health and the economy of Ukraine. Scientists from the Institute of Molecular Biology and Genetics of the National Academy of Sciences of Ukraine were among the first to join this work. On behalf of the National Security and Defense Council of Ukraine, they developed PCR test systems for diagnosing COVID-19 caused by SARS-CoV-2 coronavirus.

The Ukrainian test system for the diagnosis of coronavirus COVID-19 developed at the Institute was registered, which confirmed its accuracy and specificity at the level of 99.9%. The cost of one reaction on the Ukrainian test is UAH 250, while foreign analogues cost UAH 370-450 [27]. This test system is registered in Ukraine and is a ready-to-use kit for quantitative polymerase reaction (PCR).

The research results became the basis for the decision of The National Security and Defense Council of Ukraine and the relevant Presidential Decree, which instructed the Cabinet of Ministers of Ukraine to finance the production of 200,000 test systems by this institute.

The National Academy of Sciences of Ukraine, through internal redistribution of budget funds, increased funding for the Institute of Molecular Biology and Genetics by UAH 350,000, which should have allowed the production of 1,000 test systems. At the same time, it was agreed to allocate funds from the reserve fund of the state budget for the Institute of Molecular Biology and Genetics of the

National Academy of Sciences of Ukraine to produce a larger batch of test systems for PCR diagnostics COVID-19.

NAS of Ukraine with a significant delay received (namely 23.03.2020) insignificant funding for the creation and production of test systems, and the Institute produced the first batch of "Test systems for the diagnosis of coronavirus COVID-19" (600 tests) use to the Zhytomyr Regional Laboratory Center of the Ministry of Health of Ukraine and to the Public Health Center of the Ministry of Health of Ukraine in Kyiv. The Presidium of the National Academy of Sciences of Ukraine is in intensive negotiations with the Cabinet of Ministers of Ukraine on financing for the production of the following batches of test systems,

The National Research Center "Kharkiv Institute of Physics and Technology" became another institution of the National Academy of Sciences of Ukraine, which joined the measures to combat coronavirus. In particular, the Institute has manufactured and transferred to the reception and resuscitation department of the Regional Clinical Infectious Diseases Hospital in Kharkiv Ozone generators of its own brands Stream OzoneTM and Ozon LineTM, which are able to disinfect surfaces and air in the hospital, vehicles and everything located in them.

These ozonators are reliable and have guaranteed performance. Currently, the management of NSC KIPT is negotiating with the local administration to allocate funding for the production of a batch of ozonators for the needs of the city and region.

Another way of disinfection is radiation sterilization, which is a modern and safe for users and the environment method of industrial sterilization. And in this area, scientists of the National Academy of Sciences of Ukraine provide processing of more than 60% of all Ukrainian products that require radiation sterilization. Bandages, application bandages, protective masks, napkins, surgical sutures, pharmaceutical forms, devices for infusion of infusion solutions and blood transfusions, syringes, etc. are subjected to this method of treatment.

In particular, the National Research Center "Kharkiv Institute of Physics and Technology" in connection with the spread of coronavirus (COVID-19) by 30% increased the volume of radiation sterilization of important medical products on a radiation technology plant based on a linear electron accelerator. Using the same technology, the State Enterprise "RADMA" of the Institute of Physical Che mistry. L.V. Pisarzhevsky National Academy of Sciences of Ukraine sterilizes more than 500 items of medical products in the amount of more than 25 million products/year.

A very important area of activity of scientists of the National Academy of Sciences of Ukraine is the preparation of scientific forecasts for the spread of the COVID-19 pandemic in Ukraine, assessment of the impact of quarantine measures on the rate of infection, etc [11].

In particular, the interdepartmental Working Group on Mathematical Modeling of Problems Related to the SARS-CoV-2 Coronavirus Epidemic in Ukraine, headed by Deputy Director for Research at the Institute of Mathematical Machines and Systems of the National Academy of Sciences of Ukraine Igor Brovchenko, based on the developed mathematical SEIR-U model forecasts

the development of the COVID-19 epidemic in Ukraine and analyzes possible scenarios for the epidemic. Forecasts are preliminary because more representative and detailed data are needed for a more accurate forecast. Therefore, negotiations are currently underway with the Ministry of Health of Ukraine and the National Security and Defense Council of Ukraine to obtain such data, and forecasts will be updated on the website of the NAS of Ukraine [11].

The aggregated mathematical model of the spread of the COVID-19 coronavirus epidemic was developed by the Institute of Market Problems and Economic and Environmental Research of the National Academy of Sciences of Ukraine. It allows to describe with high accuracy the statistics characterizing the process of epidemic development in countries and regions of the world, and gives a general picture of the whole life cycle of the epidemic, as well as its main parameters in assuming the preservation of existing trends at the time of model identification [11].

Proposals have been sent to the National Security and Defense Council of Ukraine to include additional indicators in the System for Monitoring the Spread of the COVID-19 Epidemic, which is posted on the website of the National Security and Defense Council of Ukraine. They will show the current state of the epidemic as a holistic systemic phenomenon.

A significant amount of research in the context of preparation of proposals and forecasts for the leadership of the state is carried out by the institutions of the Department of Economics of the National Academy of Sciences of Ukraine. In particular, the director of the Institute of Demography and Social Research named after M. Ptukha of the NAS of Ukraine Academician of the NAS of Ukraine E. Libanovaand Director of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine, Academician of the National Academy of Sciences of Ukraine V. Geets are members of the Government Council for Economic Development of Ukraine [11].

It is clear that it will be very difficult for Ukraine to proceed from the implemented quarantine measures related to the COVID-19 epidemic, so in the framework of the Council the relevant institutions regularly prepare and submit to the Government materials with economic analysis and proposals for measures to overcome negative consequences for the economy [11].

In particular, specialists of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine conduct constant monitoring and provide conclusions on the forecast of the spread of the COVID-19 epidemic in Ukraine. The obtained statistical data allow to assess and forecast the risks of the specified course of events and to use possible preventive measures [11].

The M. Ptukha Institute of Demography and Social Research of the National Academy of Sciences of Ukraine has proposed approaches to organizational measures (at different levels of government) aimed at curbing the spread of this extremely dangerous infection.

Also in March 2020, a working group on the problems (consequences) of the spread of coronavirus SARS-CoV-2 in Ukraine, headed by Academician-Secretary of the Department of Biochemistry, Physiology and Molecular Biology of the NAS

of Ukraine, Academician of the NAS of Ukraine S. Komisarenko. Its task is to coordinate research on the development of methods for detecting coronavirus SARS-CoV-2, monitoring and aggregation of information available in various sources on the rate, geography and medical – biological and economic consequences of the spread of coronavirus SARS-CoV-2, development of measures to combat the spread of virus in Ukraine [11].

On April 3, researchers from the World Data Center for Geoinformatics and Sustainable Development, part of the Igor Sikorsky KPI under the auspices of the International Science Council, published a study entitled "COVID-19 Foresight: Impact on the Economy and Society," which presented possible scenarios for further development of the coronavirus pandemic in Ukraine.

The scenarios are based on the methodology of technological prediction, or Forsyth, which is now widely used in many developed countries. This methodology allows us to represent the future, which cannot be interpreted as a normal development of past trends.

The tools used in such research are based on methods of systems theory and systems mathematics, which can be used to solve large-scale interdisciplinary problems of various natures. Including those that arise in the course of life of complex systems, and hence – and large socio-economic entities – from individual sectors of the economy to entire states.

The need to turn to Foresight, and not to traditional methods of forecasting, is dictated by the uniqueness of the situation in which humanity now finds itself, because in modern globalization with pandemics of this magnitude, it has not yet occurred [28].

Conclusions. Today, experts say that proper testing of potentially effective vaccines takes at least 1-1.5 years, and the development of safe and effective vaccines requires three things: time, investment and numerous tests, including on animals, and clinical trials on humans. Only then regulators can allow the vaccine to be used. Wired Scientific Monthly (published in San Francisco and London) described in detail the stages of clinical trials. The authors of Wired summarize that potential vaccines began to be developed in January this year, so they can be effective only in the summer of 2021. Such calculations coincide with WHO forecasts. At the same time, no virologist will give any guarantees today. The nature of SARS-CoV-2 is still being studied and it is unpredictable.

The COVID-19 pandemic has had significant negative consequences for R&D, depending on industry and technology. The air transport, restaurant and entertainment business, and retail trade suffered the most. And due to falling incomes, the level of research funding is also declining. Current experience in taking measures to combat the spread of coronavirus in the world's leading economies shows that the greatest effectiveness is a combination of harsh, often almost authoritarian, anti-epidemiological measures and urgent increase and expansion of funding for medical science to find ways and means to overcome the epidemic, including by redistributing budget allocations, approving new financing programs, attracting domestic and international credit support and sponsorship. Investments in science become especially relevant in such periods as the global

pandemic COVID-19. As today's world practice shows, effective combating of such threats is possible due to the high level of medical science, adequate funding and investment in relevant fields, the availability of significant domestic financial, economic and other reserves and tough, rapid organization and implementation of countermeasures at the state level.

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