

T.E. Popova, O.G. Tikhonova, A.N. Romanova, A.A. Tappakhov,
M.E. Andreev, E.E. Konnikova

ANALYSIS OF THE EPIDEMIOLOGICAL SITUATION ON COVID-19: THIRD AND FOURTH WAVES

DOI 10.25789/YMJ.2021.76.17

УДК 616-036.22

The dynamic analysis of prevalence, morbidity, mortality rate and case fatality rate from COVID-19 for the period from April 1, 2021 to September 30, 2021 was carried out. The highest prevalence of COVID-19 is registered in the USA, the UK, France. China has consistently low levels of prevalence and morbidity of new coronavirus infection. Increase in the proportion of fully vaccinated persons reduces morbidity of COVID-19.

Keywords: new coronavirus infection, COVID-19, epidemiology, prevalence, morbidity, mortality rate, case fatality rate.

Introduction. 1.5 years have passed since the announcement of the novel coronavirus infection (COVID-19) pandemic (March 11, 2020) [4]. As of September 30, 2021, 234 385 740 people fell ill with COVID-19 in the world, 4 792 794 (2.04%) died, 18 403 816 (7.9%) people are sick on this date [13]. It has been found that SARS-CoV-2 is prone to genetic evolution, adapting to its new human hosts with the development of mutations over time, resulting in a variety of variants. Periodic genomic sequencing of viral samples helps detect any new genetic variants of SARS-CoV-2 circulating in communities, especially in the face of a global pandemic. Based on the latest WHO epidemiological data as of June 22, 2021, four variants (strains) of SARS-CoV-2 have been identified since the beginning of the pandemic [5]:

- Alpha (B.1.1.7): first variant of SARS-

CoV-2 described in the United Kingdom (UK) at the end of December 2020.

- Beta (B.1.351): first reported in South Africa in December 2020.

- Gamma (P.1): first recorded in Brazil early January 2021.

- Delta (B.1.617.2): first recorded in India in December 2020.

The identified new genetic mutations in SARS-CoV-2 also lead to new phenotypic manifestations of the disease. During the pandemic, "Temporary guidelines for the prevention, diagnosis and treatment of a new coronavirus infection" have been developed, which are regularly updated in Russia. Nowadays the 13.1th version of 17.11.2021 is in force [3]. The introduction of border restrictions, social distancing and infection control has reduced the pandemic in some settings, but such measures do not provide a real long-term solution given that SARS CoV-2 has become endemic [8]. Vaccination can significantly reduce the incidence of serious illness, morbidity and mortality, provided that "herd immunity" is achieved. By January 2021, more than 10 vaccines were in production using a range of established and emerging vaccine technologies, including new approaches to mRNA [9]. Mass vaccination against COVID-19 in the world began in November 2020 [7]. In the Russian Federation, mass vaccination against COVID-19 started in December 2020, at that time the United States was the world leader in the number of people who received the first dose of the vaccine. As of September 14, 2021, 42.4% of the world's population received at least one dose of COVID-19 vaccine. Globally, 5.79 billion doses have been administered and 31.56 million are currently being administered every day. Only 1.9% of people in low-income countries received at least one dose [6].

In the previous two articles, we analyzed the dynamics of the spread of COVID-19 in the Republic of Sakha (Yakutia) in comparison with other regions

of the Russian Federation and a number of foreign countries from the beginning of the pandemic to January 4, 2021. As the pandemic continues, we decided to continue the analysis of the epidemiological situation in terms of COVID -19 in the same countries that were included in the previous study, and to assess the impact of vaccination on the spread of the new coronavirus infection.

Purpose of the work: to analyze of the dynamics analysis of the epidemiological situation of COVID-19 for the period from April to September 2021 in the Russian Federation, the Republic of Sakha (Yakutia) and a number of foreign countries.

Tasks:

1. Calculate the growth rate of the spread of COVID-19 in different regions for the period from April to September 2021 (26 weeks of observation)

2. Conduct a comparative analysis of the spread of COVID-19 for three analyzed periods (I period: from January 1 to July 31, 2020 (29 weeks of observation); II period: from September 1, 2020 to January 4, 2021 (18 weeks), III period: from April 1 to September 30, 2021 (26 weeks)).

3. Compare the mortality and case fatality rates from a new coronavirus infection for the three analyzed periods.

4. To study the impact of vaccination on the prevalence of COVID-19.

Materials and methods. Epidemiological data for SARS-CoV-2 was obtained using an online platform collecting data from government agencies from April 1 to September 30, 2021, reaching 26 weeks [10-18]. The study included the same countries that were analyzed in the previous two articles: China, the USA, Spain, Italy, France, Germany, the UK, Russia, Brazil, Norway, Finland, Thailand [1-2]. For the Russian Federation, a comparison was made of data in Moscow, St. Petersburg and the Republic of Sakha (Yakutia). We analyzed the

POPOVA Tatyana E – Grand PhD in Medical Sciences, deputy Director for Science of Scientific Center for Complex Medical Problems (Yakutsk); e-mail: tata2504@yandex.ru; **ROMANOVA Anna N** – Grand PhD in Medical Sciences, Director for Science of Scientific Center for Complex Medical Problems (Yakutsk), e-mail: ranik@mail.ru; **TIKHONOVA Olga G** – Scientific Secretary of Scientific Center for Complex Medical Problems (Yakutsk), e-mail: tikhonova_olga@mail.ru; **TAPPAKHOV Alexey A** – Candidate of Sciences in Medicine, Associate Professor at the Department of Neurology and Psychiatry of the Medical Institute (North-Eastern Federal University), Head Researcher of the Laboratory of Neuropsychophysiological Researches (Medical Clinic of NEFU); Senior Researcher, Center for Neurodegenerative Diseases, Scientific Center for Complex Medical Problems (Yakutsk), e-mail: dralex89@mail.ru; **ANDREEV Michil E** – doctor of functional diagnostics at the Clinic of Scientific Center for Complex Medical Problems (Yakutsk), e-mail: michil90@mail.ru; **KONNIKOVA Edilia Eduardovna** – Candidate of Medical Sciences, Associate Professor, Medical Institute, NEFU named after M.K. Ammosov

following indicators: prevalence, morbidity of COVID-19 for 26 weeks, mortality per 100 thousand of the population, case fatality rate in % during the observation period as of September 30, 2021.

Research results. Analysis of the total number of patients in the compared countries in dynamics in terms of 100 thousand of the population (prevalence) for 26 weeks of follow-up (end date 09/30/2021) showed that the highest prevalence of new coronavirus infection was registered in the USA - 13310.4, then in the UK - 11345, in France - 10699, in fourth place is Spain - 10631.2, in fifth place is Brazil - 9820.4 cases per 100 thousand of the population (Figure 1). The lowest prevalence of COVID-19 remains in China, amounting to 6.9 cases per 100 thousand of the population (this figure remains the same). Compared to the previous observation period (September 2020 - December 2021), there is a widespread high level of the number of patients with COVID-19, in the United States there has been an increase in the number of patients by 2 times, in the UK - by 2.8 times, in France - 2.6 times, in Spain - 2.5 times, in Brazil - 2.8 times.

We also calculated new cases of coronavirus infection per 100 thousand of the population weekly (Figure 2). According to the analysis results, the "red" zone included (more than 100 cases per 100 thousand of the population per week): the USA, the UK, Norway, Thailand, Brazil, where there is a steady increase in the number of cases and the highest prevalence rates, there is no trend towards a decrease in the morbidity noted. In the "yellow" zone (the weekly morbidity rates range from 40 to 90 cases per 100 thousand of the population) are Italy, France, Finland, Russia. In the "green" zone - China, Spain, Germany, where the weekly morbidity is below 40 per 100 thousand of the population. So, in the United States, in the first week of observation, the morbidity of COVID-19 was at the level of 118.2, and at 26 weeks it increased to 515.2 per 100 thousand of the population. In the UK, the morbidity increased from 38 to 344.6 per 100 thousand of the population in 26 weeks of observation, in Norway - from 150.3 to 212.1 per 100 thousand of the population. A significant increase in the morbidity is noted in Thailand: from 0.9 to 127.9 per 100 thousand of the population for the entire analytical period, from the "green" zone, Thailand moved to the "red" zone. Italy, France, Russia have moved from the "red" to the "yellow" zone in terms of the weekly number of new cases of COVID-19, that is, in these countries, the weekly increase

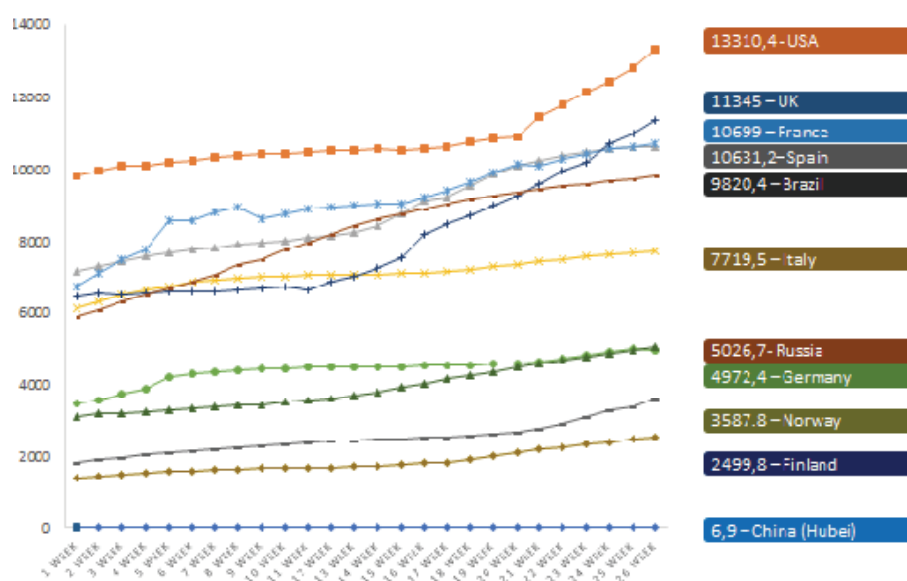


Fig. 1. The number of confirmed cases of COVID-19 (per 100 thousand of the population) in the compared countries

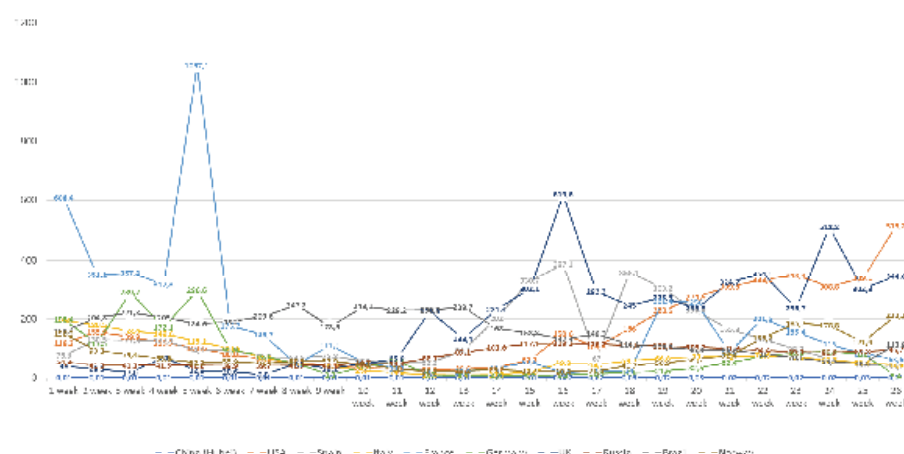


Fig. 2. New cases of COVID-19 (per 100 thousand of the population) over 26 weeks (04/01/2021 to 09/30/2021) in the compared countries

in patients has significantly decreased. Spain and Germany moved from the "yellow" and the "red" zones to the "green" zone, respectively.

Given these changes in the morbidity rates in the analyzed countries, we decided to assess the impact of vaccination on the number of new cases of COVID-19. Vaccinations in most of the countries included in our study began in December 2020. So, in the UK, the start date of vaccination falls on December 13, in China, Russia - December 15, USA - December 20, Germany, Italy, Norway, France - December 27, Finland - December 31, Brazil - January 17, 2021, Thailand - March 1, 2021.

Figure 3 shows the relationship between the proportion of fully vaccinated persons and the morbidity at 1 and 26 weeks of our analytical period. As can

be seen from Figure 3, in Spain, Italy, France, Germany, Finland, there is a decrease in the morbidity against the background of an increase in the proportion of fully vaccinated residents. For example, in France, the morbidity decreased from 608.4 to 63.6 per 100 thousand of the population when the proportion of fully vaccinated people reached the level of 67.9%. In Germany, a decrease in the morbidity rate for 26 weeks was recorded from 198.4 to 5.4 per 100 thousand of the population, while the proportion of fully vaccinated persons increased from 5.1% to 63.8%. At the same time, in countries such as the USA, Thailand, Great Britain, Norway, an increase in the morbidity of COVID-19 is noted, despite the vaccination being carried out. So, in the United States, the morbidity increased over 26 weeks of observation from 118.2 to 515.2

per 100 thousand of the population, and the proportion of fully vaccinated people reached 55.3%. In the UK, an increase in the morbidity is planned from 38 to 344.6 per 100 thousand of the population, the proportion of fully vaccinated by the 26th week of observation is 65.7%. In Norway, the morbidity increased from 150.3 to 212.1 per 100 thousand of the population against the background of reaching the proportion of fully vaccinated to the level of 66.8%. In Thailand, against the background of the late start of vaccination, the proportion of fully vaccinated persons reached 22.7% and a significant increase in the morbidity rate from 0.9 to 127.9 per 100 thousand of the population was noted. 28.9% of the population, the increase in the morbidity for 26 weeks amounted to 54.3 to 96.7 per 100 thousand of the population. In China, the morbidity for all three observation periods did not change, remaining extremely low, while fully vaccinated as of 09/30/2021 72.8% of the population

We calculated the mortality and case fatality rates in the compared regions, taking into account the total number of deaths over 26 weeks of observation as of 09/30/2021 (Figure 4). The highest mortality rate is in Brazil - 104.7, followed by Russia - 62.7, then France - 40.8 per 100 thousand of the population. The lowest mortality rate was found in China, amounting to 0.003 per 100 thousand of the population. It should be noted that in comparison with the mortality rates of the first and second waves, there is an increase in mortality in Brazil and Russia. Case fatality rate in the countries included in the study ranged from 0.09 to 1.2%, that is, we note a decrease in this indicator compared to the previous two observation periods. The lowest case fatality rate in Finland is 0.09%. In first place in case fatality rate is Russia (1.2%), in second - Brazil (1.1%), in third - Thailand (0.8%).

The mortality rate in St. Petersburg was 152.6 in Moscow - 83.5, in the Republic of Sakha (Yakutia) - 105.7 per 100 000. Mortality in St. Petersburg was 1.3% in Moscow - 0.7%, in the Republic Sakha (Yakutia) - 1.9%. Mortality rates in Russia, such large cities as St. Petersburg and Moscow, as well as in the Republic of Sakha (Yakutia) have grown significantly in comparison with the previous analytical periods.

During the analyzed period in the Republic of Sakha (Yakutia), the prevalence of COVID-19 by week 26 reached 5444.8, and the morbidity - 128.2 per 100 thousand of the population. The epidemiological situation in Russia, the rates of

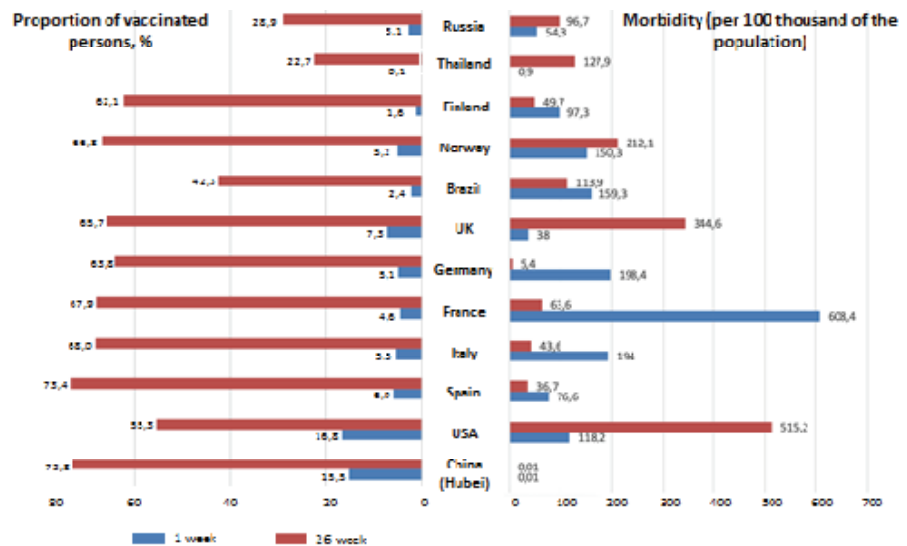


Fig.3. Vaccination and morbidity (per 100 thousand of the population) in the compared countries at the 1st and 26th weeks of observation

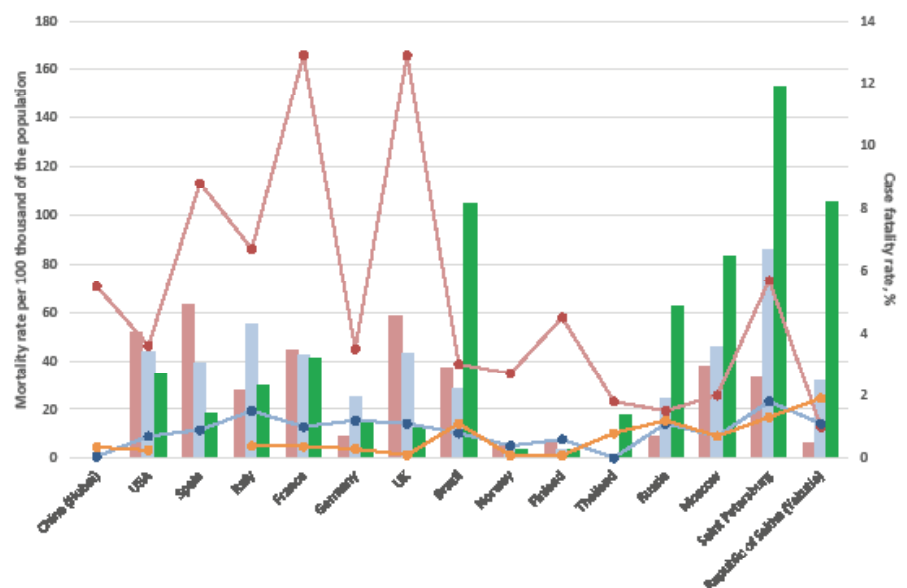


Fig.4. Mortality and case fatality rates from COVID-19 for all three observation periods: lines - case fatality rate in %, columns - mortality rate per 100 thousand of the population

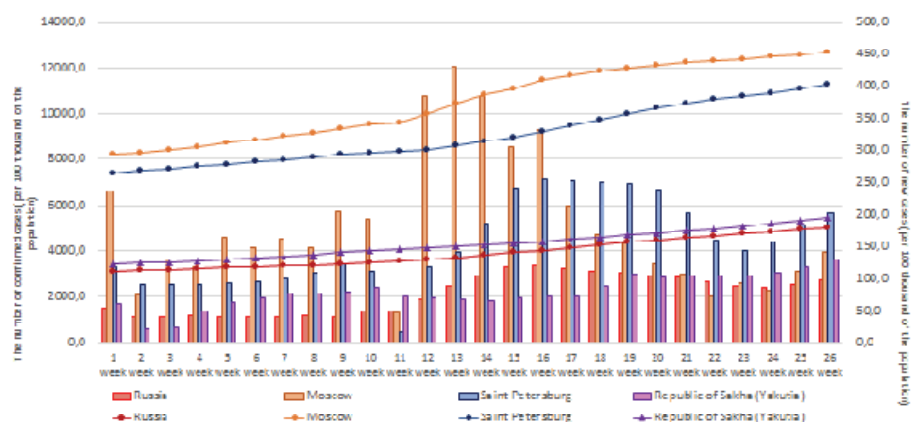


Fig.5. The number of confirmed and new cases of COVID-19 in the Republic of Sakha (Yakutia) and Russia (per 100 thousand of the population), as of 09/30/2021

both prevalence and morbidity in the Republic of Sakha (Yakutia) are comparable (Figure 5).

Conclusion. Over the almost two-year period of the COVID-19 pandemic, we have noted a continuing increase in the number of cases, the prevalence of the new coronavirus infection remains consistently high. According to our analysis, the USA, the UK, and France are leading in terms of prevalence. In China, over all three observation periods, the prevalence of COVID-19 remains at a low level, amounting to 6.9 per 100 thousand population.

In countries such as Russia, Italy, Spain, Germany, France, there is a significant decrease in the morbidity over 26 weeks of observation. In Thailand, Norway, Brazil, the USA, the UK, a steady increase in the incidence is recorded. The third and fourth waves of a new coronavirus infection in the world are caused by the spread of the SARS-CoV2 delta strain [12]. When analyzing the rate of vaccination and its effect on morbidity in the compared countries, it can be concluded that in those countries where there is a decrease in new cases of COVID-19, herd immunity has formed. In the USA, Norway, the UK, despite the sufficient coverage of the population with vaccinations, the detected increase in the incidence can be explained by the removal of restrictive measures. Also, certain questions may arise in terms of whether all vaccines used in Europe are equally effective. In Brazil, the increase in the number of cases and case fatality

rate is associated with the lack of restrictive measures in the country. China has shown a strong example of the effectiveness of strict restrictive measures and a culture of ethics that have been a key success factor in the fight against COVID-19. In addition, as of 9/30/2021, China ranks first among the countries compared in terms of vaccination coverage. Thus, only full vaccination coverage of the population and compliance with restrictive measures in the aggregate can make a positive contribution to reducing the number of COVID-19 cases and an early victory over the pandemic.

Reference

1. Анализ эпидемиологической ситуации по COVID-19. / Т.Е. Попова, О.Г. Тихонова, А.Н. Романова [и др.] // Якутский медицинский журнал. – 2020. – 3 (71). – С. 63-37. [Popova TE, Tikhonova OG, Romanova AN, et al. Analysis of the epidemiological situation for COVID-19. Yakut Medical Journal. 2020; 3 (71): 63-37. DOI 10.25789/YMJ.2020.71.17]
2. Анализ эпидемиологической ситуации по COVID-19: вторая волна. / Т.Е. Попова, О.Г. Тихонова, А.Н. Романова [и др.] // Якутский медицинский журнал. – 2021. – 1 (72). – С. 61-64. [Popova TE, Tikhonova OG, Romanova AN, et al. Analysis of the epidemiological situation for COVID-19: second wave. Yakut Medical Journal. 2021; 1 (72): 61-64. DOI 10.25789/YMJ.2021.73.17]
3. Временные методические рекомендации МЗ РФ. Профилактика, диагностика и лечение новой коронавирусной инфекции (COVID-19). Версия 13.1 (17.11.2021) [Temporary guidelines of the Ministry of Health of the Russian Federation. Prevention, diagnosis and treatment of new coronavirus infection (COVID-19). Version 13.1 (17.11.2021) (In Russ.).]

4. COVID-19 – новая глобальная угроза человечеству / Пшеничная Н.Ю., Веселова Е.И., Семенова Д.А. [и др.] // Эпидемиология и инфекционные болезни: актуальные вопросы. – 2020. – №1. – С. 6-13. [Pshenichnaya NYu, Veselova EI, Semenova DA, et al. COVID-19 - a new global threat to humanity. Epidemiologia i infektsionnye bolezni: aktual'nye voprosy. 2020; 1: 6-13. DOI: <https://dx.doi.org/10.18565/epidem.2020.10.1.6-13>]

5. Emerging Variants of SARS-CoV-2 And Novel Therapeutics Against Coronavirus (COVID-19). Aleem A, Akbar Samad AB, Slenker AK. 2021 Jul 18. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2021 Jan-. PMID: 34033342 [https://www.gisaid.org/hcov19-variants/Our World in Data Coronavirus \(COVID-19\) Vaccinations. \[\(accessed on 1 March 2021\)\]](https://www.gisaid.org/hcov19-variants/Our World in Data Coronavirus (COVID-19) Vaccinations. [(accessed on 1 March 2021)]); University of Oxford. 2021

6. The Implementation of Mass-Vaccination against SARS-CoV-2: A Systematic Review of Existing Strategies and Guidelines. Hasan T, Beardsley J, Marais BJ, Nguyen TA, Fox GJ. Vaccines (Basel). 2021 Apr 1;9(4):326. doi: 10.3390/vaccines9040326.

7. Torjesen I. Covid-19 will become endemic but with decreased potency over time, scientists believe. BMJ. 2021 Feb 18;372:n494. doi: 10.1136/bmj.n494

8. World Health Organisation . The COVID-19 Candidate Vaccine Landscape and Tracke. World Health Organisation; Geneva, Switzerland: 2021.

9. <https://covid19.who.int/region/amro/country/us>

10. <https://covid19.who.int/region/euro/country/it>

11. <https://covid19.who.int/region/wpro/country/cn>

12. <https://www.gisaid.org/hcov19-variants/>

13. <https://index.minfin.com.ua/reference/coronavirus/>

14. <https://ncov.blog/countries/us/>

15. <https://news.mail.ru/coronavirus/stat/world/>

16. <https://planetcalc.ru/8657/>

17. <https://www.worldometers.info/coronavirus/country/italy/>

18. <https://zona.media/coronagraph>

