

RESEARCH ARTICLE

European and National measurements of Molecular and Immunological aspects of Diagnosis, Prevention, and Treatment of Coronavirus infection

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ABSTRACT:

The SARS-CoV-2 coronavirus infection pandemic, which spread worldwide in 2019, has caused a large number of deaths in the population. Research on the diagnosis, prevention, and treatment of this disease requires further investigation and generalization of meaningful rules to prevent the future spread of COVID-19 and to ensure societal preparedness for such epidemics. This article reviews the problems of prevention, diagnosis and treatment of coronavirus infection within the global scientific community. The aim of the research work is to investigate the variability of diagnostic methods of COVID-19, means of prevention of the disease and main discourses for treatment of the disease. Theoretical (analysis, systematization and generalization of scientific sources) and empirical (retrospective analysis) research methods were used to study the aspects of diagnosis, prevention and treatment of coronavirus infection. Using the method of theoretical analysis, the peculiarities of the treatment of molecular-immunological aspects of diagnosis and treatment of COVID-19 were studied, and using the method of systematization and generalization, the scientific sources devoted to the issue of prevention of future coronavirus infection spread were investigated. In the article, using retrospective analysis, literature sources on the European and national view of coronavirus research were collected and systematized. As a result of the scientific research, the basic principles of coronavirus diagnostic technologies, the main stages of treatment and prevention of SARS-CoV-2 infection were analyzed.

KEYWORDS: COVID-19, SARS-CoV-2, Vaccine, Diagnostics, Epidemiology, Immunity.

INTRODUCTION:

In researching the pandemic, the first reported outbreak of Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection, dubbed COVID-19, occurred in Wuhan, Hubei Province, China. And on March 11, 2020.

The World Health Organization announced the pandemic spread of coronavirus disease worldwide¹. If we consider exactly the cause of the COVID-19 outbreak, we should focus on the interspecies transmission of CoV, due to the presence of bats in restaurants in Southern China, which led to global outbreaks of coronavirus infection. In particular, consider the horseshoe bats, which are a reservoir of SARS-CoV, and some of them and betaCoV from the subgenus Merbecovirus, which in turn are closely related to MERS-CoV².

Global health security, despite numerous previous infectious pandemics such as HIV, H1N1, SARS, MERS- CoV, and Ebola, remains quite vulnerable and unprepared for a rapid and adequate response. The spread of acute respiratory syndrome coronavirus SARS-CoV-2, which causes COVID-19, is another in a long line of pandemic outbreaks and is unlikely to be the last³.

Given the European Union's response to the spread of coronavirus disease by the world, it should be noted that Team Europe sought to mainstream and mobilize emergency development assistance for EU partner countries in coping with the spread of pandemic COVID-19⁴. However, we should also note the role of the media in keeping the peace and quenching the covid panic⁵.

Drawing attention to health research in Ukraine in 2022, the treatment of patients with coronavirus disease continues despite large-scale hostilities from Russia. Considering also the fact that Ukraine lags significantly behind its European neighbors in life expectancy and mortality rates, Ukrainian society addresses a significant portion of GDP to the health care industry. Before the war, more than 256 health care facilities throughout Ukraine were equipped with modern equipment⁶. However, despite the circumstances, the rate of coronavirus infection in the country continues to be controlled.

MATERIALS AND METHODS:

Materials:

Coronavirus infection SARS-CoV-2, called COVID-19 disease, has been studied in accordance with aspects of diagnosis, prevention and treatment based on research by European and Ukrainian scientists.

Research methods:

Methodological basis of this article on the study of European and national dimensions of molecular-immunological aspects of diagnosis, prevention and treatment of coronavirus infection is based on theoretical (analysis, systematization and generalization of scientific sources) and empirical (retrospective analysis) methods. Using the method of theoretical analysis, the treatment of molecular and immunological aspects of diagnosis and treatment of COVID-19 was investigated, and using methods of systematization and generalization, topical scientific sources on prevention of coronavirus infection were investigated. Using retrospective analysis, the literature on European and national perspectives on the study of SARS-CoV-2 infection was collected and systematized.

Methods of determining the symptoms of SARS-CoV-2 infection:

Statistical data were used to determine the percentage of symptomatic SARS-CoV-2 infected patients.

Methods of determining the advantages and disadvantages of testing technologies for the presence of COVID-19 in the body:

Determining the advantages and disadvantages of the most common methods of testing for COVID-19 has been shaped by the research of scientists who have studied the issue.

Drug loading:

The types of drugs that can be used as therapeutic agents for coronavirus infection have been studied and analyzed. Their indications and results of use have also been studied.

Entrapment efficiency:

Through an analysis of scientists' studies, the efficacy of the test drugs used in COVID-19 disease was examined.

Characteristics of medicines:

a) Determination of medicinal products

The study analyzed the most common experimental drugs that are used pathogenetically, since a cure for COVID-19 disease does not yet exist.

b) Study of the nature of medical aid in the treatment of COVID-19

The nature of medication assistance for COVID-19 disease was evaluated according to the recommendations of the Ministry of Health.

c) *In vitro* and *in vivo* research on the use of therapeutic agents against coronavirus I:

The thematic literature and works of scientists were studied to determine the properties of the therapeutic agents. Preventive agents in COVID-19 were studied because of the duration of the incubation period, which is 5 days. The very differentiation of SARS-CoV-2 infection from other respiratory diseases such as ARI (parainfluenza, rhinovirus, adenovirus, PC-virus, metapneumovirus infections), viral gastroenteritis, bacterial respiratory pathogens has an important role in the treatment.

RESULT:

Establishing symptoms of SARS-CoV-2 infection:

The mortality rate of COVID-19 combined with other social factors such as economic stress, unemployment, and fear modify this issue into a terrifying experience for humanity⁷. However, it is important to remember that timely detection of the virus in patients is essential for proper and effective treatment of patients, as well as

preventing epidemics such as the 2019 SARS-CoV-2 coronavirus outbreak that has spread to the global population and has brought a serious threat to global public health⁸. It is for this reason that molecular diagnostic or immunology-based methods should be available worldwide, especially in low-income countries, because human health must be protected from such epidemics.

To begin with, attention should be paid to the symptoms caused by SARS-CoV-2 infection (Table 1), on the basis of which patients should seek specialist care.

Usually, the disease progresses according to the duration of the illness. Consequently, on the first day, it may be fever, fatigue, muscle aches, and a dry cough, sometimes nausea and diarrhea appear a few days before the first symptoms of infection. On the fifth day, breathing becomes difficult, especially in the elderly and those susceptible to lung disease. After a week, symptoms may begin to appear, causing the patient to be hospitalized. From day eight, acute respiratory distress syndrome may develop, often causing death. Day 10 of

illness may mark the patient's transfer to the intensive care unit. In 17 days of illness, the patient, if recovered, is discharged from the hospital¹⁰.

It is important to remember that, in turn, after a patient comes to the clinic for a diagnosis of SARS-CoV-2 infection, improper collection, storage, transportation of samples or incorrect quantitative real-time reverse transcriptase polymerase chain reaction (RT-qPCR) methods become the most common causes of false test results for coronavirus infection in the patient. It is because of such errors that the development of additional methods for rapid and accurate diagnosis of patients is important¹¹.

Methods of testing for the presence of COVID-19 in the body

It is important to remember that different COVID-19 testing methods have their advantages and disadvantages (Table 2), which in turn gives patients the opportunity to choose the technology they feel most comfortable with and trust.

Table 1. Clinical symptoms of SARS-CoV-2 infection⁹

Infected patients in % ratio	60-90%	20-59%	5-19%	<5%
Symptoms of the disease	<ol style="list-style-type: none"> Heat; Cough; Shortness of breath; Lymphocytopenia 	<ol style="list-style-type: none"> Muscle pain; Presence of phlegm; Fatigue; Loss of sense of smell and taste 	<ol style="list-style-type: none"> Headache; Hemoptysis; Sore throat; Diarrhea; Confused breathing. Arthralgia; Chills; Nausea/vomiting. 	<ol style="list-style-type: none"> Swelling of the nasal mucosa; Enlarged palatine tonsils; Conjunctival hyperemia; Enlargement of lymph nodes; Rash.

Source⁹

Table 2: Advantages and disadvantages of COVID-19 testing methods

Test type	Advantages	Disadvantages
Polymerase chain reaction with reverse transcription (RT-PCR)	<ol style="list-style-type: none"> RT-PCR is recognized by scientists and physicians as a reliable and well-documented method. Because RT-PCR is a fairly common method in research and medicine, the technology already exists to test for COVID-19. RT-PCR can detect current infections, which in turn allows the identification of infected and healthy individuals 	<ol style="list-style-type: none"> RT-PCR is based on capturing and detecting the virus, allowing patients who have recovered from a viral infection to pass. Transmission of COVID-19 occurs via different respiratory routes from one to the other patient, so even if a person is infected, coronavirus is only detected in sputum or nasopharyngeal swab, but not necessarily in both places simultaneously. RT-PCR for COVID-19 can only detect a specific type of coronavirus and therefore does not provide information about other diseases or symptoms.
Loop-mediated isothermal amplification (LAMP)	<ol style="list-style-type: none"> LAMP is a fairly quick diagnostic method, giving results in 2-3 hours. Clear result. The simple and cheap LAMP technique allows for use in local hospital laboratories, which shortens the time between receiving the sample and establishing the patient's diagnosis. The method detects existing infections, allowing the identification of sick and healthy patients. 	<ol style="list-style-type: none"> The technology is newer than traditional RT-PCR, so it does not have much research experience; therefore, this technology is still being evaluated in clinical settings. LAMP technology is more complex than RT-PCR. Using such a test, it is possible to miss patients who have recovered from COVID-19. Transmission of COVID-19 disease occurs via different respiratory routes from one to the other patient, so even if a person is infected, the coronavirus is only detected in sputum or nasopharyngeal swab, but not necessarily in both places at the same time. LAMP tests for COVID-19 can only detect a specific type of coronavirus, and therefore does not provide information about other diseases or whether the patient is immune to the virus.

Immunochromatography with side flow / colloidal gold	<ol style="list-style-type: none"> 1. The results are ready in 15 minutes. 2. Sampling is noninvasive. 3. This test does not require much preparation to perform or specialized laboratories or scientists. 	<ol style="list-style-type: none"> 1. Lateral flow test technology is new, so it is still being evaluated. 2. It is possible to determine if a person was infected at a certain point, so additional testing is needed to determine if the infection is present in the body at the time of the test. 3. Such tests are expensive and time-consuming.
Enzyme-Linked Immunosorbent	<ol style="list-style-type: none"> 1. The test is simple and inexpensive. 2. ELISA is known and scientifically documented in medicine. 3. Results are ready within 1-3 hours. 4. Because the test is fast - diagnosis time is reduced. 5. The ELISA test is used for fast and scalable testing. 	<ol style="list-style-type: none"> 1. The effectiveness of ELISA tests in determining COVID-19 is not well understood, but many global companies are working to develop and test such a test on patients.

Source:¹²

Thus, with the help of the list of methods and technologies for testing coronavirus infection, the public has the opportunity to choose which method suits them and diagnose the virus in time.

Additional diagnostics:

Usually, strains of the virus with low pathogenicity, such as HCoV-229E, HCoV-OC43, HCoV-NL63 and HCoV-HKU, affect the human upper respiratory tract, which then cause cold symptoms and correspond to mild to moderate severity in healthy people. Approximately 15-30% of all colds are such strains of the virus. In turn, the highly pathogenic strains that cause severe acute respiratory syndrome, that is, SARS-CoV, Middle East respiratory syndrome - MERS-CoV, or COVID-19 (SARS-CoV-2), cause the impression of the lower airways, which consequently causes severe pneumonia¹³. To prevent pneumonia, doctors prescribe magnetic resonance imaging (MRI) because it uses radio waves and powerful magnetic fields to image the inside of the human body, which allows timely prevention and diagnosis of upper or lower airway impressions¹⁴.

The practice of providing medical care in Ukraine:

In Ukraine in the provision of medical care in cases of mild to moderate severity should pay attention to the following points. If the course of the disease is mild, i.e. the patient has no breathing difficulties, first of all it is necessary to give the patient details of the need for adequate nutrition during treatment and appropriate rehydration of the body, as well as to prescribe symptomatic treatment with antipyretics for fever and pain. It is also important in such cases to consider the use of direct-acting COVID-19 antiviral drugs for the at-risk patient. However, in the case of moderately severe disease, the contraindication of corticosteroids for patients who do not require oxygen support should be emphasized in addition to providing nutritional and body temperature reduction recommendations. In cases of

laboratory-confirmed concomitant bacterial infection, the contraindication of antibacterial agents should be noted. In cases of breathing complications, it is advisable for the patient to be in a horizontal position on the abdomen, which induces opening of the alveoli to increase blood oxygen levels. Prescribing favipiravir and direct-acting antivirals for at-risk groups should also be considered. In the severe course of COVID-19, optimal supportive therapy, oxygen support, and administration of corticosteroids are necessary. In the critical course of infectious disease, optimal supportive therapy, mechanical lung ventilation, and low-molecular-weight heparins are necessary. Intravenous systemic corticosteroids are also recommended. In the critical course of COVID-19, prophylaxis and treatment of acute respiratory distress syndrome and subsequent pulmonary fibrosis should be prescribed. If bacterial flora attach to it, the use of antibacterial or antifungal agents is recommended¹⁵.

Medical drugs against coronavirus infection:

We should note the fact that there are still no specific drugs for the treatment of respiratory infections such as SARS-COV-2 in the world, which becomes a cause of pathogenetic treatment of patients. So far, more than 350 clinical trials of various drugs are known with which, in the long term, it will be possible to overcome the coronavirus disease. Scientists are still studying the effect of various drugs on patients with COVID-19, antiviral, antibacterial, antimalarial drugs, immunostimulants, anticoagulants, and even covalent plasma therapy¹⁶. However, COVID-19 treatment allows the use of certain experimental drugs (Table 3) that can alleviate the symptoms and course of coronavirus disease. However, it is important to assess, understand and anticipate the negative effects of experimental drugs¹⁷.

Table 3: Medicines for COVID-19

Medicinal products	Nature of COVID-19 Disease Relief	Research Findings
Remdesivir	The nucleotide analogue is active against SARS-CoV-2 and related coronaviruses (including SARS- and MERS-CoV).	Reduces the duration of fever and reduces the mortality rate of COVID-19.
Chloroquine	Has an antiviral effect against SARS-CoV-2.	High probability of developing toxic manifestations of said drug, namely QTc prolongation, cardiomyopathy, and toxic retinal damage.
Hydroxychloroquine	Enhances the ability of SARS-CoV-2 RNA to disappear.	An increasing number of countries are refusing to use hydroxychloroquine for COVID-19.
Favipiravir	Accelerates viral clearance and shows positive radiologic dynamics compared to other treatment regimens.	Studies of the drug are ongoing.
Lopinavir-ritonavir	Plays very little or no role in the treatment of COVID-19 disease.	No differences have been found in the rate of symptom relief.
Tocilizumab	The drug has been shown to reduce the cytokine storm in the lungs of patients than reduce mortality in coronavirus disease.	Studies of the drug are ongoing.
Glucocorticoids	It is used to treat critically ill patients.	Increases risk of death and results in delayed viral clearance.
Plasma transfusion from donors who have fully recovered	In patients the viral load in nasopharyngeal swabs decreased, as well as the severity of the disease and improved arterial blood oxygen saturation on day 12 after administration of plasma to patients.	Studies are ongoing.

Source¹⁸

There are also studies on the herbal effects on SARS-CoV-2 infection. Consequently, synthesis of the molecular composition of turmeric, neem, ginger, and pepper showed the potential to form components for the further development of drugs against COVID-19¹⁹.

The practice of providing medical care in the European Union:

In the European medical space, the prophylaxis strategy for SARS-CoV-2 coronavirus infection maintains collective immunity, changing in line with vaccination progression. As a result, based on reproductive numbers of 2.5-3.5, immunity is required in 60-72% of the population, but this rate is higher for more transmissible variants. Due to the more transmissible variants, COVID-19 requires a minimum population immunization rate of 80%²⁰.

A mucosal booster vaccine against COVID-19 coronavirus, as opposed to vaccination by intramuscular injection, is one way to achieve stronger immunity and protection against reinfection with future variants of the mutant SARS-CoV-2 virus. Systemic mRNA in symbiosis with mucosal Ad5-S vaccination results in strong cellular immunity in the respiratory tract and convincing mucosal IgA and neutralizing activity against the common 2022 Omicron BA.1.1 virus variant²¹.

In the fight against SARS-CoV-2 coronavirus infection, it is important to remember that the main resistance that society can offer is individual protection itself, counteracting spread through isolation if infected, and vaccination as prevention of future disease. It is also important to wear a mask in crowded places, ventilate rooms, try not to be in crowded places, wash your hands with soap, and cough into a curved elbow or tissue²².

DISCUSSION:

In late 2019, the world realized the reality of the COVID-19 pandemic, which comes from the orthocoronavirin subfamily of SARS-CoV-2 and MERS²³. In Europe, the Corona Response initiative of the European Commission was included in the spring of 2020 to provide 37 billion euros to citizens of European Union regions and member states to offset the effects caused by the COVID-19 pandemic. In turn, the European Union Solidarity Fund has allocated some in health and business support²⁴.

It is important to note that quarantine measures imposed in European Union territories, which included moving educational institutions to an online format, closing entertainment and sports facilities, introducing the idea of telecommuting, and restricting the movement of citizens on the streets unnecessarily reduced the risk of acute respiratory disease COVID-19²⁵.

The European Center for Disease Control, in turn, monitors the level of risk to the European Union population, providing rapid risk/outbreak assessments that support countries in their preparedness to respond to public health threats. The European Center for Disease Control performs surveillance, epidemic intelligence, rapid response in the event of a new pandemic threat, provides scientific advice, trains health professionals, and is responsible for international health relations and communication. Such measures are implemented because the European Union, in order to counteract misinformation about COVID-19 and premature panic, provides transparent, timely and fact-based information that performs a public calming function²⁵.

In turn, Ukrainian medical policy prevents the spread of SARS-CoV-2 infection by adhering to sanitary and hygienic measures, namely through systematic disinfection of water, appropriate heat treatment of food, systematic hand washing and disinfection of public areas. Essential in the policy of preventing the recurrence of outbreaks of coronavirus disease are anti-epidemic measures, including early detection of patients, their isolation, quality treatment of COVID-19 patients²⁷.

Vaccination of the population against SARS-CoV-2 infection is the main and specific method of prevention against COVID-19 disease. It is also important to follow nonspecific preventive measures to prevent the infection and spread of coronavirus infection, i.e., avoid crowded places and wear personal protective equipment including a mask²⁸, because this infection spreads when a person infected with the virus coughs or sneezes²⁹. However, unlike most Western European countries, in Ukraine there is a problem of motivation for mass vaccination of the population, because the European vaccination program, unlike the Ukrainian one, has several advantages³⁰. It should also be noted that for 2022 in Ukraine, where a full-scale war has been launched by Russia against the Ukrainian people, vaccination of the population against the SARS-CoV-2 infection, the cause of COVID-19, is ongoing to prevent the spread of the disease in the future³¹.

It is also important to take advantage of the time between pandemics to customize the development and implementation of response models for such situations and epidemics, and in turn to measure and address any competencies that have not been established. Educational campaigns aimed at healthcare workers and the public on the spread and prevention of COVID-19 should be increased³². A field such as outbreak science has great potential and could potentially be a driving force for improving public health preparedness at the scale of global pandemics. In examining potential threats to public health, it is important to focus on the experience of previous pandemic years in shaping solutions, especially those related to infectious diseases³³.

CONCLUSION:

Summarizing the research work on the European and national dimensions of molecular-immunological aspects of diagnosis, prevention and treatment of coronavirus infection, attention should be paid to the formation of strong links of the global scientific community in the field of public health to improve the epidemiological situation. Focusing on the modernization of diagnostic tools, scientists are looking for new ways to prevent and treat COVID-19 disease.

According to the results of the scientific research it should be noted that drugs for counteraction to SARS-CoV-2 infection are still at the stage of development and research, however some experimental means, such as remdesivir, tocilizumab have proved to be promising means for fighting covid.

As a result of this research work, the following results were formed. The main problem in diagnosing coronavirus disease is the rapid response of the infected person to the symptoms that provoke an exacerbation of the disease. However, after detection and systemic treatment of COVID-19, the patient can choose the treatment by which the symptomatic course of the disease can be mitigated. It is important to pay public attention specifically to preventing the spread of SARS-CoV-2 infection through vaccination. It is vaccination, as practical experience shows, that is the driving force in overcoming pandemics.

Considering that the world and European, in particular, scientific communities continue researching the health industry from such pandemics, and that Ukrainian researchers study the spread of COVID-19 in a state of war, research on diagnosis, treatment and prevention of SARS-CoV-2 infection should be continued. Researchers on this topic should delve deeper into the COVID-19 pandemic phenomenon and analyze future research and public health developments in general.

CONFLICT OF INTEREST:

The authors have no conflicts of interest regarding this investigation.

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