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PREDICTION AND PREVENTION OF COMPLICATIONS OF LONG COVID IN COPD AND ASTHMA

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Summary.

Background. Patients with chronic obstructive pulmonary disease (COPD) and bronchial asthma belong to the high-risk group for severe COVID-19 and the development of long COVID.

This study **aimed** to assess long COVID complications in COPD and asthma patients and to substantiate preventive measures based on international data and experience of the Republic of Moldova.

Methods. A review of scientific publications from 2020–2025 was conducted, along with analysis of official reports and normative acts of Moldova, including estimates of long COVID prevalence were calculated.

Results. Pre-existing COPD and asthma increase the risk of long-term post-COVID sequelae by approximately 30–40%. Long COVID complications predominantly include chronic dyspnea, fatigue, reduced exercise tolerance, worsened control of the underlying disease, and psycho-emotional disorders. In Moldova, tens of thousands of people are estimated to suffer from post-COVID complications, but systematic case recording is absent.

Conclusions. Implementation of key preventive measures is required: full vaccination and boosters for at-risk groups, early administration of antivirals, continuous control of COPD/asthma, as well as development of rehabilitation and monitoring programs for patients with long COVID.

Keywords: long COVID, COPD, bronchial asthma, post-COVID syndrome, rehabilitation, vaccination, respiratory failure.

Rezumat. Prognozarea și profilaxia complicațiilor long COVID în BPOC și astm bronșic.

Context. Pacienții cu boală pulmonară obstructivă cronică (BPOC) și astm bronșic prezintă risc sporit de forme grave de COVID-19 și dezvoltare a sindromului long COVID.

Scopul studiului a fost evaluarea complicațiilor long COVID la pacienții cu BPOC și astm și fundamentarea măsurilor profilactice, bazându-ne pe datele științifice internaționale și experiența Republicii Moldova.

Metode. Am realizat o trecere în revistă a literaturii științifice din 2020–2025, s-a efectuat analiza rapoartelor oficiale și actelor normative din Republica Moldova, cu estimări ale prevalenței long COVID în lipsa datelor exacte.

Rezultate. BPOC și astmul pre-existent cresc riscul de sechele post-COVID cu aproximativ 30–40%. În rândul complicațiilor long COVID predomină dispneea cronică, oboseală, toleranță redusă la efort, control agravat al bolii de bază și tulburări psiho-emoționale. În Moldova, se estimează că zeci de mii de persoane suferă de complicații post-COVID, însă evidența sistematică lipsește.

Concluzii. Se impune implementarea măsurilor profilactice: vaccinarea completă și revaccinarea grupelor de risc, administrarea precoce a antiviralelor, controlul continuu al BPOC/astmului, precum și dezvoltarea programelor de reabilitare și monitorizare a pacienților cu long COVID.

Cuvinte cheie: long COVID, BPOC, astm bronșic, sindrom post-COVID, reabilitare, vaccinare, insuficiență respiratorie.

Резюме. Прогнозирование и профилактика осложнений long COVID при ХОБЛ и бронхиальной астме.

Актуальность. Пациенты с ХОБЛ и астмой относятся к группе высокого риска тяжелого течения COVID-19 и развития long COVID.

Целью работы была оценка осложнений long COVID у данной группы пациентов и обоснование профилактических мер с учётом международного и молдавского опыта.

Методы. Проведён обзор литературы за 2020–2025 гг., официальных отчётов и нормативных актов Молдовы, а также выполнена расчётная оценка распространённости long COVID.

Результаты. ХОБЛ и астма увеличивают риск длительных последствий COVID-19 на 30–40%. Среди осложнений long COVID преобладают хроническая одышка, усталость, снижение переносимости физической нагрузки, ухудшение контроля основного заболевания, психоэмоциональные расстройства. В Молдове число таких пациентов оценивается в десятки тысяч, но их системный учёт отсутствует.

Заключение. Ключевые меры профилактики включают вакцинацию групп риска, своевременную противовирусную терапию, регулярный контроль астмы и ХОБЛ, а также создание программ реабилитации и мониторинга пациентов с long COVID.

Ключевые слова: long COVID, ХОБЛ, бронхиальная астма, постковидный синдром, реабилитация, вакцинация, дыхательная недостаточность.

Introduction.

The COVID-19 pandemic has given rise to a new medical and social problem known as *long COVID*, or post-COVID syndrome. This term refers to a condition, in which symptoms that appeared during acute SARS-CoV-2 infection persist or reappear weeks or months after recovery [24]. According to the World Health Organization (WHO) definition, post-COVID condition is characterized by symptoms lasting ≥ 2 months and occurring within 3 months since the onset of COVID-19 illness that cannot be explained by another diagnosis [42]. The most frequent manifestations of long COVID include rapid fatigue, dyspnea, sleep disturbances, and cognitive impairment [23, 42]. It is estimated that long-term post-COVID effects occur in 10–20% of recovered patients [23]. By early 2023, at least 65 million people worldwide were suffering from long COVID symptoms [23]. At the same time, most cases are among recovered patients who had a relatively mild acute form of the infection [23], thus indicating the unpredictability of this syndrome's development.

The post-COVID syndrome can develop in anyone who has endured COVID-19, however there are factors increasing its likelihood [42]. These include female gender, older age, obesity, smoking, and presence of concomitant chronic diseases [41]. Chronic respiratory diseases, such as chronic obstructive pulmonary disease (COPD) and bronchial asthma, are particularly important. These pathologies are accompanied by chronic inflammation of the airways and structural changes in the lungs, which can contribute to both a more severe acute course of COVID-19 and the development of long-term complications. Thus, in patients with COPD, ACE2 receptor' expression in the bronchi is increased whereas immune inflammation is enhanced, leading to a more severe lung damage by coronavirus infection [29]. Early in the pandemic, the meta-analysis showed that the presence of COPD is associated with an increased risk of hospitalization, ARDS, and lethality in COVID-19 [13]. Bronchial asthma, especially severe asthma, has also been considered as a risk factor for developing severe COVID-19 [24], although the data is contradictory: according to GINA updates, patients with well-controlled mild and moderate asthma do not show an increased likelihood of severe COVID-19 [24]. However, recent studies

amply testify that both asthma and COPD increase the risk of precisely long-term post-infection complications [36, 41]. A systematic review of 51 studies determined that having bronchial asthma prior to COVID-19 increases the chances of developing long COVID by approximately 41%, and COPD by 32% compared to people without these diseases [36]. Another study (prospective cohort) also showed a tendency towards a higher risk of long COVID in patients with asthma (OR ~ 1.9) and allergic rhinitis [41]. Thus, patients with chronic respiratory diseases are a vulnerable group, for whom the issues of prognosis and prevention of long COVID complications are relevant.

In the Republic of Moldova, the first case of COVID-19 was registered on March 7, 2020 [40]. During the three years of the pandemic (2020–2023), approximately 635,000 cases of coronavirus infection and over 12,000 deaths were officially confirmed in the country [48]. Given the country's population (about 2.6 million), this means that at least a quarter of the population has endured COVID-19. There has been no special record of long COVID syndrome in Moldova, however, based on global estimates ($\approx 10\%$ of out-patients suffer from long-term effects [23]), therefore it can be assumed that tens of thousands of patients in Moldova have experienced post-COVID complications. The scale of the problem is indirectly evidenced by the burden on the healthcare system: persisting demand for rehabilitation services, visits to healthcare facilities with post-COVID complaints, etc. At the same time, until recently there were no official clinical protocols for the management of patients with long COVID. It was only in 2021 that the WHO introduced a special code U09.9 in the ICD-10 to designate post-COVID-19 status, though unspecified. This was included in the national clinical protocol for COVID-19 in the Republic of Moldova [25, 26]. The latest IX edition of the National COVID-19 Protocol (approved by Ministry of Health Order No. 594 of July 5, 2024 [27]) pays attention to post-COVID complications, however no statistical data on incidence of disease complications is provided. Thus, in Moldova, as in many countries, there is no complete epidemiological picture of the prevalence of long COVID yet, in particular in patients with COPD and asthma. This makes it difficult to forecast the health system's needs for rehabilitation and

specialized care. This review aims to fill in this gap by analyzing international experience and summarizing available information on regional characteristics of long-standing COVID in patients with chronic lung diseases.

The aim of the study – analysis of the complications in case of long COVID syndrome in patients with COPD and bronchial asthma and development of evidence-based recommendations for their forecasting and prevention, taking into account the experience of the Republic of Moldova and international data.

To achieve this goal, the following objectives were set: to study the incidence and risk factors for long COVID development in patients with COPD and asthma; to characterize the clinical manifestations and outcomes of post-COVID complications in this group; to compare the experience of the Republic of Moldova in managing such patients with international practices; to propose a set of preventive and rehabilitation measures aimed at reducing the risk of long-term consequences of COVID-19.

Materials and methods.

The study design is a narrative review with elements of epidemiological analysis. Scientific publications (2020–2025), official reports from the Ministry of Health and the National Public Health Agency of Moldova, regulatory documents, as well as materials from the WHO and the GOLD and GINA initiatives were used.

The literature was found in data bases of PubMed, Web of Science, and Google Scholar databases using keywords in Russian and English, as well as materials from practicing pulmonologists were used. The identified sources of information were evaluated for sample representativeness and relevance to the population of the Republic of Moldova. A comparative summary of data was carried out by extracting key quantitative indicators (risks, shares, statistically significant effects). In the absence of national data, extrapolations of international indicators were used. The study placed the emphasis on the results of meta-analyses and systematic reviews, as well as on the official positions of the WHO and relevant professional communities with the aim to increase the credibility of its conclusions.

Results and discussion.

1. Prevalence of long COVID in COPD and asthma

Official statistics in the Republic of Moldova shows that chronic obstructive pulmonary diseases (COPD) and bronchial asthma are significant health problems. According to the national Ministry of

Health and the National Bureau of Statistics, the number of registered patients with asthma accounts to tens of thousands. In particular, experts note that only about 10–15 thousand adults and approximately 1.3–1.5 thousand children with diagnosis of asthma are officially registered [46]. This is significantly lower than the estimated actual prevalence: according to estimates, more than 160,000 people suffer from asthma in Moldova, which is approximately 4% of the population [47]. Such a difference indicates an under-diagnosis—far from all cases of asthma are recorded in the official register. As for COPD, according to estimates for 2017, there were registered about 138.9 cases per 10,000 adults [9], that is about 1.4% of adults have had diagnosed COPD. This corresponds to approximately 25,000–30,000 patients (the indicator is likely to have increased slightly by 2020–2024). According to the WHO, the prevalence of COPD increases sharply with age, with one in ten people over the age of 40 having the disease [13]. Overall, bronchial asthma is more common among children and people over 40 [12], whereas COPD mainly affects older people, especially smokers (historically more common among men, although the gender gap is gradually narrowing).

The incidence of COVID-19 among patients with asthma and COPD in 2020–2024 has as well become a subject of close attention. Overall, approximately 600,000–635,000 cases of COVID-19 have been registered in Moldova during the pandemic [34, 40], and a significant proportion of those infected had concomitant chronic lung diseases. The accurate local data on how many people with asthma and COPD have had COVID-19 has not been officially published. However, based on international studies, reasonable estimates can be made. According to meta-analyses, a range between 1% and 17% of all patients with COVID-19 also had concomitant asthma [21] (this indicator varied between countries, reflecting differences in asthma prevalence), while the average share of asthma among those infected was close to its prevalence in the population. For COPD, this indicator is slightly lower, with an average of about 2% of COVID-19 cases occurring in patients with COPD [2, 3]. Extrapolating these figures to Moldova's statistics, it can be assumed that during the pandemic tens of thousands of asthmatics and several thousand patients with COPD have had coronavirus infection. Despite initial concerns, the presence of asthma alone did not significantly increase the risk of severe COVID-19; moreover, some reviews even noted a slightly lower susceptibility of asthmatics to infection [35]. COPD, on the contrary, is associated with a more severe course: COPD patients have

a higher risk of hospitalization and complications from COVID-19, although the share of these patients among those infected is small (since COPD is a disease of the elderly, and there are few young people infected with COVID among this group).

Long-term consequences of COVID-19 (long COVID) in patients with asthma and COPD are a pressing issue, for which there are no official statistics in Moldova yet. The lack of local data is compensated by the use of international studies adjusted for regional characteristics. Overall, it is estimated that 10–30% of people who have had COVID-19 experience some form of long-term symptoms (according to various studies and criteria) [19]. The presence of chronic respiratory disease may increase this likelihood [36]. Thus, studies support the hypothesis that previous asthma or COPD increases the risk of long COVID—for example, development of chronic fatigue and respiratory complaints are registered more often in these patients [36]. As demonstrated by one British longitudinal study, the risk of prolonged symptoms in asthmatics was by 32% higher than in people of similar age without asthma [19]. Particularly revealing data was obtained by a survey conducted in the UK among asthma patients: from approximately 4,500 respondents with asthma, 10.5% got sick with COVID-19, and more than half of them (56%) reported about developing long COVID [19]. That is, every second asthmatic who endured COVID-19 suffered from prolonged post-COVID symptoms, and these patients reported noticeably more frequent shortness of breath, the need to use inhalers more often, and overall worsening of asthma control after infection [19]. In the case of COPD, there is less systematic data available. Some separate observations are contradictory: the study of the database of British general practitioners, the presence of COPD (including chronic bronchitis and emphysema) did not show a statistically significant increase in the risk of prolonged symptoms (a trend of $OR \approx 1.53$ was noted, but the 95% CI included 1) [19]. However, other studies report the opposite – for example, in a prospective observation of patients with COPD discharged from hospital, many of them continued to have symptoms 12 months after COVID-19, significantly more often than patients without COPD [19]. Thus, it can be assumed that COPD patients who have had severe COVID-19 are at risk for long COVID, although moderate COPD does not always appear as a risk factor for long-term effects [19].

Age and gender aspects of the prevalence of long COVID should be noted. The risk of long-term post-COVID effects increases with age: for example, in the British study mentioned above, long-

term symptoms were reported in ~17% of recovered patients with an average age of 58, while in the group with an average age of 28 only ~7.8% cases reported [19]. This is particularly relevant for patients with COPD, as most of them were from older age groups. According to a number of studies, women report the development of long COVID slightly more often than men (in the general population), although specific data on asthma/COPD are limited. In the Republic of Moldova, asthma itself is slightly more common in women of working age, while COPD is more often in men over 50 (which is associated with the prevalence of smoking). However, as these factors level out, the gender structure of morbidity in the future will possibly change.

Thus, based on the extrapolation of international data to the situation in Moldova, it can be assumed that approximately 10% of patients with COPD and a significantly higher number of asthmatics have experienced long COVID syndrome. This confirms the need for a special approach to the rehabilitation of this group after infection.

2. Clinical manifestations and complications of long COVID in patients with COPD and asthma

Respiratory symptoms

Persistent respiratory symptoms are one of the central components of post-COVID syndrome, especially in individuals with chronic lung disease. The most common complaint is persistent dyspnea (shortness of breath during physical activity and, in severe cases, at rest). It is observed even in patients who had minimal respiratory symptoms prior to COVID-19. In patients with COPD who have had coronavirus pneumonia dyspnea often worsens compared to their pre-COVID condition, which is associated as with exacerbation of the underlying disease, as well as with possible residual changes in the lungs (fibrosis, decreased diffusion capacity) [8, 13]. Chronic cough is another common symptom of long COVID, occurring in a significant share of patients with asthma and COPD. It may be the result of ongoing airway inflammation or nerve endings dysfunction after viral damage. Decreased tolerance to physical activity – many patients complain of rapid fatigue, dyspnea and palpitations when trying to return to normal activity. In people with COPD, this is caused by a combination of post-COVID weakness (asthenia) and worsening bronchial obstruction. A study by Moldovan pulmonologists noted that COVID-19 in patients with COPD leads to an increased chronic fatigue and a decreased level of daily activity in the long term [41]. Thus, the viral infection seems to set back the condition of

respiratory patients, which is equivalent to several years of natural disease progression.

Exacerbations and progression of the underlying disease

One of the serious consequences of COVID-19 is long-term disruption of chronic respiratory disease control. According to prospective observations, some patients experience exacerbation of bronchial asthma after even mild COVID-19. For example, in a study by Brazilian allergologists, 33.9% of patients with asthma who endured COVID-19 had noticed a worsening in asthma control (increased frequency of symptoms, the need for higher doses of inhaled steroids), while among asthmatics who did not have COVID-19, only 11.4% reported such worsening [1]. In other words, COVID-19 almost tripled the risk of long-term worsening of asthma progression. This mainly referred to those who had COVID-19 with lower respiratory tract symptoms. Even after recovering from acute infection, such patients often require escalation of basic therapy (e.g., switching from low to medium and high doses of steroids) to regain asthma control [43]. The observations are similar in patients with COPD: after COVID-19, they may experience an increase in the frequency of COPD exacerbations requiring antibiotics and systemic steroids, although in the first months of the pandemic, a paradox was reported: a decrease in overall hospitalizations of patients with exacerbations due to quarantine measures and reduced contact with other infections [13, 26]. As long as social activity returned to normal, the post-COVID COPD patients turned to become prone to more frequent episodes of worsening, probably due to residual damage to lung tissue and blood vessels. Besides, COVID-19 can lead to accelerated decline in lung function. Some studies have reported a decrease in FEV1 and diffusion capacity in outpatients after 6–12 months of infection compared to baseline values, which is alarming in terms of the possible progression of COPD [30]. In the most severe cases of COVID-19 (e.g., after mechanical ventilation), patients with COPD develop persistent respiratory failure requiring long-term oxygen therapy at home.

Systemic (extrapulmonary) complications

Long COVID is a multisystem condition [23], and patients with chronic lung disease may also develop damage of other organs. For example, there is evidence of an increase in cardiovascular events after COVID-19: myocardial infarcts, strokes, thromboembolisms. Patients with COPD already have an increased cardiovascular risk, and post-COVID endotheliitis and hypercoagulation can exacerbate it [13, 22]. There are also reported cases of new endocrine

disorders (e.g., manifestation of diabetes mellitus) and exacerbation of existing metabolic pathology/ This is important to consider, as many COPD patients are elderly people with multimorbidity. Neurological and cognitive symptoms (so-called “brain fog”) are often described in long COVID [23]. Patients complain of memory loss, poor concentration, and sleep disorders. For patients with asthma and COPD, such cognitive impairments can be particularly challenging, as successful management of their underlying disease requires adherence to a treatment regimen, proper inhalation techniques, etc., which is difficult with cognitive problems. Psychological aspects: prolonged illness, dyspnea, and fear of suffocation cause anxiety and depression. It has been shown that asthmatics and COPD patients experienced high levels of depression and anxiety during the pandemic [8], while long COVID only aggravates the psychological burden. All of these negatively affects the quality of life of patients.

Regional features of the clinical picture

In the Republic of Moldova, no specific differences in the manifestations of long COVID have been noted, however there are some *highlights*: First, due to the lack of specialized clinics, the majority of patients are seen by primary care doctors. Family doctors report that the most common complaints of post-COVID patients remain dyspnea at physical activity, weakness, and emotional lability (tearfulness, anxiety). Second, a significant share of patients are rural residents who may be less likely to seek repeated care, thus the real complication rate may be higher than reported. Third, Moldova has a historically strong pulmonology school focused on rehabilitation (having extensive experience in rehabilitation after tuberculosis and pneumonia). This potential has been used to help post-COVID patients. Since autumn 2020, with WHO support, methodological materials for patients on recovery from severe COVID-19 have been distributed [28]. Brochures with breathing exercises, voice exercises, dietary guidelines, and psychological self-help tips have been translated into Romanian and Russian [28]. Ten thousand copies of these brochures in Romanian and 5,000 in Russian were distributed free of charge in hospitals [28]. This indicates awareness of the problem at the national level and attempts to solve it through patient education. However, there is still no specialized service for the management of long COVID; patients with severe residual symptoms are usually referred to relevant specialists: pulmonologists (for persistent shortness of breath, cough), cardiologists, neurologists, psychologists, etc., depending on the leading symptoms. Such fragmented approach differs

from that of a number of developed countries, where multidisciplinary “long COVID” clinics have been set up, bringing together different specialists under one roof. In Moldova’s conditions, it is difficult to set up separate centers, yet the possibility of integrating the services of a rehabilitation specialist, psychotherapist, and social worker into the structure of polyclinics is being considered aiming to provide comprehensive care to post-COVID patients. Vaccination coverage is an important regional factor as well: in Moldova, about 40% of the population is fully vaccinated against COVID-19 [40]. This coverage is lower than in Western Europe, which may have led to a higher number of severe cases and, consequently, a higher share of long COVID. Studies show that vaccination reduces the risk of developing post-COVID syndrome [10, 38]. Therefore, countries with lower vaccination coverage (including the Republic of Moldova) potentially face a greater burden of long-term complications.

3. Prevention of long COVID complications in COPD and asthma

Given the significant prevalence and severity of post-COVID complications, the development of preventive measures is of primary importance. Prevention should be multi-layered, ranging from preventing infection itself to preventing the development of severe consequences in those who have already had the disease. Key prevention strategies are summarized below:

Prevention of COVID-19 itself

Obviously, the best prevention for long COVID is not to get ill by COVID-19. It is extremely important to minimize the risk of infection in patients with COPD and asthma. Vaccination and booster shots are recommended as a priority for people with chronic lung disease [10, 38]. The existing research has demonstrated that a full course of 2–3 doses of mRNA vaccine significantly reduces the likelihood of developing long COVID (in some studies by up to 50%) by preventing severe infection [38]. In addition to vaccination, precautions should be taken during the ongoing circulation of the virus: wearing masks during the season of increased respiratory infections, avoiding contact with sick people, and hand hygiene. These recommendations are especially relevant for patients with COPD/asthma, as even common ARIs can be severe in these patients. Prevention of reinfection with COVID-19 deserves special mention, as each new episode may increase the risk of cumulative damage (reinfection is considered by the WHO to be a risk factor for post-COVID conditions [42]). Patients should therefore continue to exercise caution after recovering from COVID-19.

Timely treatment of acute infection

If a patient with asthma or COPD got infected with SARS-CoV-2, efforts should be made to reduce the severity of the disease and the inflammatory response, thereby reducing the likelihood of long-term consequences. Modern antiviral drugs (e.g., nirmatrelvir + ritonavir, monoclonal antibodies for susceptible strains) should be administered as early as possible in high-risk groups. In line with international recommendations, patients with COPD are among those who should receive early antiviral therapy for COVID-19 in an ambulatory setting. Clinical observations indicate that the use of nirmatrelvir in the first 5 days of illness reduces not only the risk of hospitalization but also the frequency of post-COVID symptoms after 3 months, although further studies are needed to draw definitive conclusions. In addition, during the acute phase of COVID-19, treatment of the underlying disease should be optimized: patients with asthma should continue inhaled corticosteroids (it has been noted that discontinuation of ICS for “safety” reasons is not justified, as their continuation does not worsen COVID-19 outcomes [14], on the opposite - it rather maintains asthma control). COPD patients should receive standard prevention of exacerbations (bronchodilators, antibiotics if necessary). Adequate oxygen therapy for hypoxia and thromboprophylaxis in the hospital are all components of proper COVID-19 treatment and also serve to prevent long-term complications, since severe organ damage in the acute phase correlates with long-term consequences [42]. Thus, the motto is: treat actively now to treat less later.

Dynamic monitoring and screening for complications

After enduring COVID-19, patients with COPD and asthma should be closely monitored. A follow-up examination is recommended in the period of 1–3 months after recovery: assessment of lung function (spirometry, peak flow measurement), chest X-ray or CT scan (in severe pneumonia – to detect fibrosis), a set of minimum laboratory tests (inflammation markers, coagulation profile if a prothrombotic state is suspected). This allows for the detection of complications that have developed, such as signs of post-COVID pulmonary fibrosis. Although no specific treatment for fibrosing alveolitis after COVID-19 has been developed, early detection gives patients the chance to be included in rehabilitation programs to improve respiratory function. Monitoring is also necessary to identify new chronic conditions that have developed after infection, such as diabetes mellitus, hypothyroidism, and neurological disorders. It is important for doctors to ask about symptoms

that patients may not complain themselves (e.g., cognitive complaints, depression) – quality of life questionnaires (SF-36) and anxiety/depression scales can be used for this purpose. In Moldova, it is advisable to introduce a standard for the management of COVID-19 recovered patients: after one month, the family doctor fills out a symptom checklist and, if necessary, refers the patient to specialists. This proactive approach facilitates timely intervention and prevents the worsening of post-COVID problems.

Rehabilitation

One of the cornerstones of preventing the progression of long COVID is medical rehabilitation. It is recommended to start rehabilitation as early as possible, immediately after the acute phase.

For patients with lung damage, pulmonary rehabilitation programs have been developed that are similar to rehabilitation after pneumonia and exacerbations of COPD: breathing exercises, gradual increase in physical activity, resistance exercises to train the respiratory muscles. The WHO emphasizes that rehabilitation can significantly improve the functional status of patients with post-COVID syndrome [42]. Since the beginning of 2021, the Republic of Moldova has already taken the first steps towards introducing a post-COVID rehabilitation system. Specialists from health resorts and hospital rehabilitation departments have been involved in this process, and methodological guidelines have been developed and published [28]. However, the coverage is still insufficient. Expanding the coverage of rehabilitation services will improve access to them in district and rural healthcare institutions, as well as teach patients simple self-help techniques, such as breathing positions and relaxation methods. According to the Ministry of Health of the Republic of Moldova, special brochures with exercise routines were published in 15,000 copies [28]; it is important to actively use these materials in clinical practice and give them to patients upon discharge. Regular physical activity tailored to the patient's abilities (walking, therapeutic exercise) prevents the development of physical inactivity, muscle deficiency and associated weakness. In addition to physical exercise, rehabilitation should include psychological support: teaching methods for coping with stress and anxiety (breathing exercises, muscle relaxation techniques). This is especially important for people who have undergone severe resuscitation, as they often experience post-resuscitation syndrome with depression and PTSD. Psychologists and psychotherapists should become an essential part of the multidisciplinary team managing long COVID.

Optimizing the treatment of COPD and asthma

Preventing complications of long COVID also involves maintaining remission of the underlying disease. After COVID-19, doctors should review the asthma/COPD treatment plan: it may be necessary to temporarily increase the intensity of treatment. For example, patients with asthma who have experienced a deterioration in asthma control should have their ICS doses increased or added to, and anti-leukotriene drugs should be added. In COPD, the focus is on maximum bronchodilation: the use of long-acting combination inhalers (long-acting β_2 -agonists + anticholinergics) improves lung function. Monitoring inhaler technique is essential, as post-COVID cognitive impairment can lead to incorrect use of devices. Nurses and doctors should retrain patients on how to inhale medications correctly. In addition, treatment of all comorbidities is indicated: adequate control of heart failure, hypertension, and diabetes will contribute to better overall tolerance of the effects of COVID-19. Patients who have had severe COVID-19 may require more frequent follow-up with a cardiologist (to monitor post-myocardial changes) and a neurologist (for neurological symptoms). Thus, the prevention of complications is a team effort, with pulmonologists, internists, and other specialists coordinating their efforts.

Lifestyle and self-care

Last but not least is patient-centered prevention, i.e., measures that patients themselves can take to improve their condition and prevent deterioration. These include adequate rest and sleep (the WHO recommends paying special attention to sleep hygiene in post-COVID insomnia [42]), a balanced diet (recovery from illness requires sufficient protein and vitamins), and avoiding harmful habits (patients with COPD should stop smoking, as this will reduce inflammation in the airways and the risk of thrombosis). Breathing exercises and practices (e.g., slow deep breathing, diaphragmatic breathing) can help manage shortness of breath and anxiety. Patients should be advised on energy conservation: alternate between activity and rest, do not try to return to the previous level of activity immediately, but increase it gradually [23, 42]. If new or worsening symptoms appear (e.g., rapid heartbeat, sudden weakness), consult a doctor immediately, without dismissing them as something that will go away on its own. Overall, helping patients understand their condition and develop self-management skills is key to ensuring that post-COVID syndrome does not last longer than it needs to.

Conclusion.

Patients with COPD and bronchial asthma belong to the group most susceptible to developing complications of long COVID syndrome.

Analysis of literature data and Republic of Moldova's experience has shown that pre-existing chronic inflammatory diseases of the respiratory tract increase the risk of post-COVID-19 symptoms by approximately 30–40%, as well as the risk of their persistence for 3 months and more. The most often complications of long COVID in this cohort include: persistent dyspnea (including enhancement of dyspnea compared to the pre-COVID state), chronic cough, decreased exercise tolerance and the need for prolonged oxygen therapy (in severe COPD patients), prolonged deterioration in control of the underlying disease (need for more intensive basic therapy for asthma/COPD), asthenic syndrome (general weakness, fatigue), cognitive dysfunction, and psychological problems (anxiety and depressive disorders). These consequences negatively affect the quality of life of patients, lead to loss of working capacity and create additional burden on the healthcare system. In the Republic of Moldova, the problem of long COVID in patients with chronic lung diseases is relevant, although accurate statistics are not available. Approximately tens of thousands of citizens may have experienced some manifestations of post-COVID syndrome requiring medical intervention. The Moldovan experience demonstrates the need for early rehabilitation and a multidisciplinary approach, but also reveals shortcomings, such as the lack of specialized long COVID centers, fragmented monitoring, and limited resources in peripheral healthcare.

Based on the carried analysis, measures have been identified to improve the forecast and prevention of long COVID complications in patients with chronic lung diseases such as COPD and asthma.

First, improved recording and monitoring are needed. A post-COVID syndrome registration system shall be introduced and standardized protocol for monitoring patients after COVID-19 shall be developed, which entails regular screening for symptoms (e.g., one, three, and six months after illness). An electronic registry of such patients will allow for more accurate assessment of the scale of the problem and effective planning of healthcare resources.

Second, vaccination should be strengthened and patient's awareness raised. Vaccination campaigns should continue, emphasizing their importance not only for preventing severe disease, but also

for reducing the risk of long-term consequences of COVID-19. Patients should receive clear information about the symptoms of long COVID and specific actions to be taken if their condition worsens.

The third direction - development of early rehabilitation and multidisciplinary care. It is important to train doctors and nurses in rehabilitation methods that take into account the specific characteristics of COPD and asthma, using the capabilities of specialized institutions. Access to rehabilitation services must be ensured immediately after the acute phase of the disease, especially in rural areas, using telemedicine technologies and mobile teams.

Fourth - updating clinical protocols and professional training for doctors. Clinical guidelines should include algorithms for prognosis of long COVID complications, and healthcare workers should be trained to identify and treat complications in a timely manner, paying attention to the mental state of patients.

Finally, a personalized approach to prevention and support for scientific research with international cooperation are important. The development of individual prevention and rehabilitation programs, as well as participation in international projects, will allow to effectively reduce the consequences of long COVID and improve the quality of life of patients with chronic lung diseases.

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