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System for the provision of specialised medical care for Covid-19 with comorbid diseases

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Abstract. The purpose of the study was to examine the features of organising specialised care for patients with coronavirus infection and chronic diseases, followed by an assessment of its effectiveness and possibilities for improvement. The study had a theoretical-analytical character and included a comparison of six clusters: Kyrgyzstan as an example of a country with limited resources, the USA, European states (France, Germany, Italy, Spain, Poland), Asian countries (Thailand, Singapore, Indonesia, South Korea, India, Malaysia), as well as China and Japan with the centralised organisational models. The analysis was based on publications, statistics and clinical guidelines from 2020-2025; cross-country comparison was applied with a conditional points-based assessment of severity in comorbid patients and the development of recommendations for improving care. The analysis showed that in multimorbidity the severity score reached 16 points, and in cardiovascular, respiratory diseases and immunodeficiencies – 15. Two or more chronic pathologies increased the risk of severe course and death by 2-3 times. In China and Japan, in-hospital mortality was 5.5-6%, with severe renal failure in Japan – up to 28%. In the USA the mortality among patients with several chronic diseases exceeded 12% with an overall rate of 2.5%, the load on emergency departments reached 25-30%. In Europe the increase in mortality in peak periods was about 20%, with resource deficits – up to 50-60%, among oncology patients in Italy and Spain – more than 25%. In Kyrgyzstan with multidrug-resistant tuberculosis, the indicator reached 34-36%. The obtained data confirm the dependence of outcomes on the severity of comorbidities and health-care resources, which requires risk stratification, adaptation of protocols and strengthening of staffing and infrastructure potential. The results can be used by health authorities and medical institutions to optimise care for patients with coronavirus infection and chronic diseases

Keywords: hospitalisation; mortality; routing; risk stratification; oxygen therapy; telemedicine; multidisciplinary team

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Introduction

According to the World Health Organisation, during the 28-day period from 6 January to 2 February 2025 more than 147 thousand new cases of coronavirus infection and over 4.5 thousand deaths were registered worldwide, which underlined the persistence of a significant global burden of infection [1]. These indicators reflect the colossal global burden of infection; however, the most vulnerable category remains patients with comorbid diseases – arterial hypertension, diabetes mellitus, chronic lung diseases, obesity and cardiovascular pathologies. In such patients the risk of a severe course and fatal outcome increases by 2-3 times compared with individuals without concomitant pathology, which requires a clearly structured system of specialised medical care, including early risk stratification, priority access to antiviral agents and oxygen support, as well as multidisciplinary management. Despite the completion of the acute phases of the pandemic, the continued significant circulation of SARS-CoV-2 and the high proportion of the population with chronic diseases make the improvement of clinical-organisational technologies for this group of patients a strategic priority of health systems in all countries.

International experience in organising specialised care for patients with COVID-19 and comorbid diseases demonstrates significant variability in clinical and organisational approaches. In the study by Y. Asai *et al.* [2], conducted in Japan, it was established that the prescription of antiviral and immunomodulatory therapy was determined not only by the severity of the condition and the comorbidity profile, but also by regional protocols, which indicated the need to unify standards. These 2024 data reflected an already mature stage of the pandemic and recorded trends that persisted in the post-pandemic period. In a national Chinese sample of 1,590 patients, as shown by W. Guan *et al.* [3], an increase in the number of concomitant pathologies raised the risk of severe course and fatal outcome. The conclusions of the study formed the basis of practical recommendations for risk stratification and the organisation of care pathways for patients with multimorbidity.

In the article by Q. Zhang [4], updated versions of Chinese clinical protocols were analysed, emphasising the priority of managing patients with chronic diseases, including algorithms for prescribing oxygen therapy and criteria for hospitalisation. The scientific novelty was expressed in the systematisation of accumulated clinical experience and the adaptation of standards to changing strains of SARS-CoV-2. Multicomorbidity, according to C.D. Russell *et al.* [5], was a leading factor of an unfavourable prognosis, and the combination of several chronic diseases exerted a synergistic negative effect on the course of COVID-19. This conditioned the need to implement integrated multidisciplinary models of care and coordinated interaction between outpatient and inpatient levels.

The systemic consequences of the COVID-19 pandemic for health care and the management of patients with chronic diseases were manifested both in the clinical and organisational spheres. In the review by T. Kendzerska *et al.* [6] it was noted that the redistribution of resources and the change in priorities led to delays in diagnosis, changes in treatment regimens and reduced availability of planned care for chronic patients. Even developed health systems experienced overload, which worsened the control of chronic conditions. The presence of comorbid diseases, as shown by A. Fitero *et al.* [7], increased the risk of complications and mortality in COVID-19 approximately two to three times, and the restriction of access to preventive and supportive services aggravated the course of chronic pathologies. The authors emphasised that during the pandemic negative factors were amplified due to reduced availability of specialised care, which decreased by almost 50% in European countries (the Netherlands, Sweden, the United Kingdom), aggravating the course of chronic diseases. In the work by G. Fekadu *et al.* [8], it was shown that the COVID-19 pandemic led to disruption of programmes for regular follow-up of patients with chronic diseases, limited access to medicines and laboratory monitoring, which negatively affected the quality of the medical support. The researchers pointed to the need to expand remote medical support and adapt organisational models to conditions of crisis load.

The experience of Kyrgyzstan in organising specialised care for patients with coronavirus infection and concomitant diseases reflected both common problems (overload of hospitals, shortages of staff and equipment, restriction of planned care) and nationally specific solutions (repurposing anti-tuberculosis beds, using approaches from tuberculosis and human immunodeficiency virus programmes), as well as attracting international support. In the study by R. Akmatova *et al.* [9], it was established that the pandemic not only changed the perception of respiratory infections in vulnerable population groups, but also contributed to increased interest in preventive measures, including influenza vaccination, which is considered an element of a comprehensive strategy to protect patients with multimorbidity. According to data presented by B. Rechel *et al.* [10], the health system of Kyrgyzstan rapidly adapted during the pandemic: it repurposed institutions, mobilised personnel and established inter-agency interaction for the routing of patients with COVID-19 and chronic diseases. The priority became expanding access to oxygen therapy and updating intensive care protocols. A. Taalaibekova *et al.* [11] established that health workers considered it necessary to develop long-term support programmes for patients after COVID-19 with an emphasis on rehabilitation, psychosocial care and coordination between levels of the medical service. Such measures ensure the integration of post-COVID care into the health system, which makes it possible to improve the quality of life of patients with comorbidity.

In the studies conducted, gaps persisted related to the absence of a holistic assessment of the effectiveness of specialised medical care for patients with COVID-19 and comorbid diseases in an international context, taking into account the specifics of clinical-organisational technologies. The aim of the study was a comprehensive analysis of the system of specialised medical care for patients with COVID-19 and concomitant chronic diseases to assess its effectiveness and directions for improvement. The objectives of the study were as follows: to determine the impact of comorbid diseases on the clinical severity of the course of COVID-19, the frequency of complications and the level of mortality; to identify the features of the impact of the pandemic on health systems and the specifics of managing patients with chronic diseases and determine successful models for organising specialised care; to characterise international experience followed by the development of recommendations for its optimisation.

Materials and Methods

The present study had a theoretical-analytical character and was based on the study and comparative analysis of scientific publications, statistical reports and clinical guidelines for 2020-2025. The analysis covered six territorial clusters: the Kyrgyz Republic, singled out separately due to unique resource constraints and adaptation solutions, the USA, European states (France, Germany, Italy, Spain, Poland), Asian countries (Thailand, Singapore, Indonesia, South Korea, India, Malaysia), as well as China and Japan. Such geographical coverage was determined by the need to identify both universal and specific organisational-clinical solutions in health systems with different levels of resources, the structure of the medical-sanitary network and experience in responding to the pandemic.

Within the study the list of comorbid diseases was determined on the basis of clinical guidelines and epidemiological reviews [12-14], including data on cardiovascular pathologies (arterial hypertension, ischaemic heart disease, chronic heart failure), endocrine-metabolic disorders (type 1 and type 2 diabetes mellitus, obesity), chronic respiratory diseases (chronic obstructive pulmonary disease, bronchial asthma), oncological processes, chronic kidney and liver diseases, as well as immunodeficiency conditions, including human immunodeficiency virus (HIV infection). Particular attention was paid to multimorbidity, in which the combination of two or more chronic diseases intensified the severity of the course of COVID-19. For each case, indicators of the frequency of hospitalisations, length of stay in hospital, the need for oxygen support and mechanical ventilation, the level of mortality, as well as the presence of complications, including acute respiratory distress syndrome, sepsis and multiple organ failure, were analysed. The severity of the course of COVID-19 in patients with comorbid conditions was assessed conditionally by the sum of points assigned to each of the key clinical-organisational indicators: admission to an intensive care unit (ICU) – 3 points; length of hospital stay more than 14 days – 2 points; need for oxygen support – 1 point, for mechanical ventilation – 3 points; presence of severe complications – 3 points; fatal outcome – 4 points. A total score from 0 to 5 was interpreted as a mild course, 6-10 – as moderate, over 10 – as severe (the maximum value was 16 points). Based on these criteria, integral severity assessments were constructed for various disease groups and a comparison of mortality indicators in different health-care models was carried out.

For cross-country comparison official statistical reports of the World Health Organisation [15], World Bank [16], European Centre for Disease Prevention and Control [17], the United States Centres for Disease Control and Prevention [18], as well as national clinical guidelines and protocols of the Ministry of Health, Labour, and Welfare of Japan [19], the National Health Commission of the People's Republic of China [20] and the National Institute for Health and Care Excellence [21] of the United Kingdom were used. On the basis of these materials, in all clusters the structural and functional parameters of organising specialised care for patients with COVID-19 and concomitant diseases were analysed. At the same time, the availability of specialised hospital beds, the capacity of ICUs, provision with oxygen and mechanical ventilators, staffing potential and the preparedness of medical personnel, as well as routing protocols, algorithms for early risk stratification and interaction between primary, specialised and rehabilitation levels were considered. Additionally, the degree of adaptation of clinical recommendations and the introduction of telemedicine technologies were assessed, as well as indicators of morbidity, hospitalisations and mortality were analysed. On the basis of the analysis carried out and the cross-country comparison of data, recommendations were formulated to improve clinical-organisational approaches to managing patients with COVID-19 and comorbid diseases. These recommendations took into account the specifics of national health systems, the identified organisational barriers and effective models of providing specialised care, which ensured the applicability both in conditions of high resource provision and in countries with limited capabilities.

Results

Comorbidity and multimorbidity as determinants of outcomes

The complex influence of comorbid conditions on the course of COVID-19 is determined by a combination of immunological, vascular and metabolic disorders, which intensify hypoxaemia, systemic inflammation and thrombotic complications. Meta-analyses and large cohort studies demonstrate that the simultaneous presence of several chronic diseases increased the risk of severe COVID-19 and death by more than 2-3 times, and also raised the likelihood of developing multiple organ failure [13,22]. In patients with cardiovascular pathologies (arterial hypertension, ischaemic heart disease, chronic heart failure) SARS-CoV-2 infection was significantly more often complicated by acute coronary syndromes (approximately 1.7-2.5 times more often than in patients without these diseases), decompensation of cardiac function, life-threatening arrhythmias and thromboembolic events [15,18]. The main pathogenetic mechanisms are endothelial dysfunction, hypercoagulation and cytokine-mediated microcirculatory disorders, which clinically manifest as increased dyspnoea, chest pain, haemodynamic instability and the need for high-flow oxygen therapy [16]. In COVID-19 the cardiovascular phenotype is an important indicator of the risk of ICU admission and in-hospital mortality [21,23].

Disorders of endocrine and metabolic regulation, including type 1 and type 2 diabetes mellitus and excess body weight, contributed to a more severe course of COVID-19 due to chronic subclinical inflammation, insulin resistance and increased thrombotic activity [13,20]. In patients with diabetes there is more often extensive lung involvement, prolonged fever, bacterial superinfections and septic complications, which is associated with a high need for oxygen support and increased length of hospital stay [18,24]. Metabolic decompensation, including ketoacidosis, often develops against a background of hypoxia and systemic inflammation, requiring comprehensive correction [21,25]. Excess body weight worsens the mechanical parameters of breathing, reduces ventilation efficiency and increases the risk of respiratory failure even with moderate changes on chest computed tomography [16,22].

Chronic respiratory diseases, primarily chronic obstructive pulmonary disease, aggravate the course of COVID-19 through remodelling of the bronchial tree, a reduction in respiratory reserve and impaired mucociliary clearance [19]. This leads to early development of respiratory failure, refractory hypoxaemia and a sustained need for oxygen therapy. In severe or uncontrolled bronchial asthma, COVID-19 more often causes exacerbations requiring systemic glucocorticosteroids, which increases the risk of secondary bacterial complications [22]. Pathomorphological data indicate a high proportion of chronic respiratory diseases among those who died from COVID-19, pointing to the role as a significant factor of adverse outcome [24].

In oncological patients, the main factor of a severe course is secondary immunodeficiency, caused both by the tumour itself and by anti-tumour treatment [13,15]. This contributes to more intensive viral replication, rapid progression of lung involvement, a high frequency of sepsis, thromboembolism, and multiple organ failure. When oncopathology is combined with other comorbid conditions there is a marked increase in mortality, as well as longer use of oxygen support and complex antibacterial regimens [18,19]. Chronic kidney disease increases susceptibility to a severe course of COVID-19 due to uraemic immunodeficiency, endothelial dysfunction and electrolyte disturbances [17,20]. Acute kidney injury often develops during hospitalisation, complicating management and increasing the risk of death [14]. In liver cirrhosis, COVID-19 often causes decompensation of portal hypertension, hepatic encephalopathy and coagulopathy, increasing the risk of septic complications and prolonging rehabilitation [22].

Immunodeficiency states, including HIV infection, substantially complicate control of the inflammatory process. A low CD4 cell count and high viral load are associated with severe hypoxaemia, frequent opportunistic infections (Pneumocystis pneumonia, invasive mycoses) and a prolonged need for broad-spectrum antibacterial therapy [15,20]. The combination of immunodeficiency with metabolic or respiratory pathologies amplifies the negative effect, leading to the rapid development of respiratory failure even in moderate virus-induced pneumonia [19]. The assessment of the severity of the influence of comorbid diseases on the course of COVID-19 was carried out conditionally, based on an integral scoring system: ICU admission – 3 points; length of inpatient treatment more than 14 days – 2; need for oxygen support – 1; mechanical ventilation – 3; presence of severe complications (acute respiratory distress syndrome, sepsis, multiple organ failure) – 3; death – 4. A total score of 0-5 points corresponded to a mild course, 6-10 to a moderate course, and above 10 to a severe course. Figure 1 presents a conditional integral assessment of the severity of the influence of different groups of comorbid diseases, performed taking into account the frequency of hospitalisations, length of inpatient treatment, need for oxygen and respiratory support, as well as the frequency of severe complications and deaths.

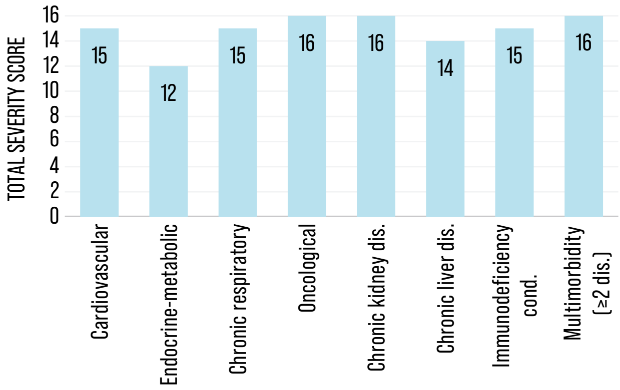

Figure 1. Conditional assessment of the severity of the influence of various groups of comorbid diseases on the course of COVID-19

Note: the end point was marked at 16, since this is the maximum number of points that a patient could receive with the simultaneous presence of all criteria

Source: compiled by the authors as a result of data analysis [13,14,22-25]

As a result of the analysis of the data presented in the graph, it was established that in all highlighted groups the total score exceeded 10 points, which corresponds to a severe course of COVID-19. The maximum values (16 points) were noted in patients with oncological diseases, chronic kidney disease and multimorbidity, which reflects a combination of severe factors associated with an increased risk of adverse outcome and the need for comprehensive, intensive treatment. These groups are characterised by a combination of several critically significant factors – pronounced organ dysfunction, severe immune disorders, high thrombotic activity and a predisposition to sepsis. Such a combination leads to a longer hospital stay, the need to apply complex treatment protocols, and a substantial increase in mortality. The values of 15 points obtained for cardiovascular pathologies and chronic respiratory diseases reflect a severe course due to decompensation of the underlying condition, pronounced respiratory failure, thromboembolic complications and the need for continuous oxygen support. Immunodeficiency states show a comparable level of severity (15 points), which is associated with the body's low ability to control inflammation and a high frequency of secondary infections. For chronic liver diseases (14 points) an increased risk of coagulopathies, bleeding and septic complications is typical, whereas endocrine-metabolic disorders (12 points) more often manifest as worsening hypoxaemia, chronic inflammation and metabolic decompensation, especially when combined with other pathologies. Consequently, each additional point on this conditional scale indicates the layering of yet another clinically significant factor which, in real conditions, leads to an increased probability of an adverse outcome and requires a more intensive and multidisciplinary approach to patient management. Thus, the conditional integral scale made it possible to identify the most vulnerable groups of patients. However, COVID-19 outcomes with similar comorbidity varied significantly depending on the resources and organisation of national healthcare systems, as reflected in Figure 2.

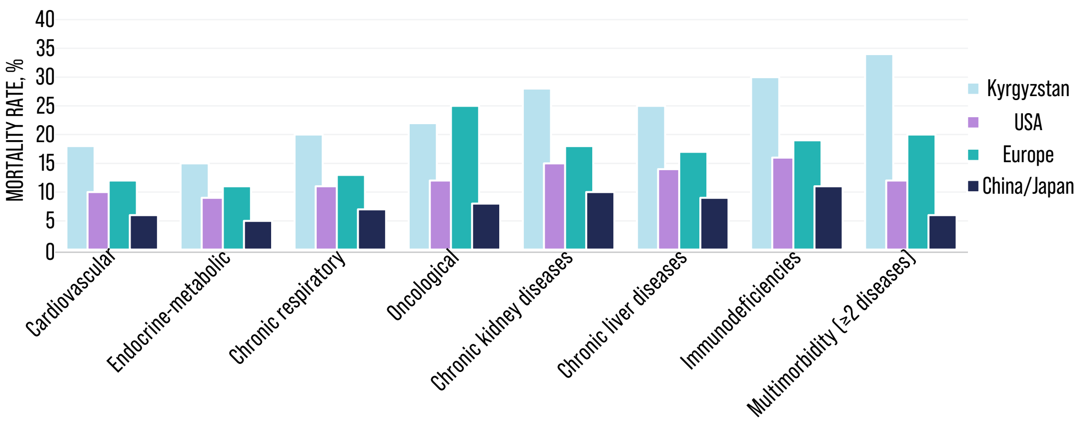

Figure 2. Mortality from COVID-19 in patients with comorbid conditions in different healthcare models (Kyrgyzstan, USA, Europe, China/Japan)

Source: compiled by the authors as a result of data analysis [13-21]

The graph showed that mortality from COVID-19 in patients with comorbidities differed substantially depending on healthcare models. In Kyrgyzstan the highest figures were recorded: mortality in cardiovascular pathologies reached 18%, in respiratory diseases about 20%, and in chronic kidney disease and multimorbidity exceeded 28-34%. These data reflected limited resources, a deficit of oxygen support and personnel, and a high prevalence of background diseases. In Europe the figures were lower; however, overload of ICUs during peak periods led to increased mortality, especially among oncological patients, where it reached 25%. In the USA the values remained moderate – about 12% in the presence of two or more chronic diseases, which was explained by better technical equipment and standardised protocols, although a high burden on emergency care limited access to intensive therapy. In China and Japan mortality in most groups did not exceed 5-10%, reflecting a high level of resource provision, centralised planning of bed capacity, effective routing and the use of telemedicine. Thus, identical comorbid conditions in different countries led to different clinical outcomes: with a shortage of resources mortality rose to a third of patients, whereas with developed infrastructure and strict protocols these figures decreased almost threefold.

The analysis carried out demonstrated that comorbid diseases were key determinants of a severe course of COVID-19 and adverse outcomes. The impact was enhanced in multimorbidity; however, the severity of the consequences depended substantially on the capabilities of healthcare systems: in resource-limited countries (for example, Kyrgyzstan) mortality figures were significantly higher, whereas developed infrastructure and clear routing (China, Japan, European states, USA) made it possible to reduce the risk of complications and death. The analysis confirmed that effective management of such patients required the integration of clinical and organisational strategies.

International models of specialised care: structure, resources and clinical-organisational technologies

Systems of specialised care for comorbid patients with COVID-19 in six clusters demonstrated pronounced differences in the level of resource provision, organisational structure and clinical-organisational technologies used. In the Kyrgyz Republic, with initially limited material-technical base and staffing, a flexible tactic of repurposing beds to a respiratory profile and redistributing functions between tiers of care and within teams was applied, which increased the elasticity of routing during peak loads [26]. The use of vertical programmes for tuberculosis and HIV infection to borrow algorithms of infection control and management of vulnerable groups was noted; however, there remained deficits in oxygen provision and ventilators, as well as fragmentation between tiers of medical care [27]. The advantages of such a configuration were flexibility of flows and adaptation of protocols to local resources; the disadvantages were uneven staff training and weak resilience of long rehabilitation pathways.

In the USA, a decentralised model operated with high technological equipment, powerful ICUs and developed telemedicine [28,29], yet at an early stage of the pandemic serious failures in the availability of elective and outpatient care were recorded, accompanied by reduced utilisation and overload of emergency services [30]. Standards of remote monitoring, routing of high-risk patients and maintenance of continuity in the management of chronic cardiology patients were rapidly implemented [31]. The strengths of the model are high technical potential and an extensive telemedicine network; the weaknesses are variability of protocols between states, overload of emergency departments and high vulnerability of patients with psychiatric and addictive comorbidities [32].

In European countries (France, Germany, Italy, Spain, Poland), hybrid models predominated with a strong role for the primary tier and regional coordination [33]. Service quality remained heterogeneous, especially during peak periods when reductions in elective care and delays in routing chronic patients were recorded [34]. More effective systems demonstrated a better ratio of resources to outcomes, and large cohort data confirmed the need for early risk stratification and multidisciplinary pathways [35]. Advantages – institutionalised coordination and resilient primary-care channels; disadvantages – inter-country variability and overload of hospitals at peaks.

In Asian countries (Thailand, Singapore, Indonesia, South Korea, India, Malaysia, and others), integration of primary healthcare and public health services was widely used, with an emphasis on the family doctor as a "gateway", tracing and rapid routing [36,37]. Alongside this, the pandemic was accompanied by interruptions in care for patients with non-communicable diseases and reduced continuity of follow-up, which adversely affected comorbid patients [38]. Strengths of the approach – early routing, remote formats and integration with public health; weaknesses – limited intensive-care resources in peripheral areas and the vulnerability of non-communicable disease programmes (such as cardiovascular disease, diabetes, chronic respiratory and oncological pathologies) during peak loads.

China implemented a centralised, protocol-oriented model with unified stratification algorithms, large-scale repurposing of bed capacity and accelerated deployment of oxygen infrastructure [37,38]. This ensured high manageability and uniformity of processes, but was accompanied by overload risks with a sharp rise in incidence and the need for rapid strengthening of human resources and rehabilitation tiers [39]. To support serviceability, remote channels and the transfer of functions to the outpatient segment were actively applied.

In Japan, centralised clinical standards were combined with a developed system of national registries and detailed in-hospital risk stratification [40]. Practice included the integration of specialised therapy for vulnerable groups, including patients with severe renal failure, including evaluation of the effectiveness of antiviral regimens in multidisciplinary hospitals. Advantages of the model – high equipment levels, rapid calibration of protocols and developed multidisciplinary pathways; disadvantages – local overloads during surges and the need to ensure continuous follow-up of chronic patients when resources are reallocated (Table 1).

Table 1. Comparative characteristics of international models of specialised care for comorbid patients with COVID-19

Cluster	Model type	Resources and routing	Telemedicine	Advantages	Disadvantages
Kyrgyzstan	Adaptive under shortage; repurposing of beds	Variable provision of oxygen and mechanical ventilation; task-shifting, borrowing of algorithms (tuberculosis/HIV)	Targeted use for case conferences and training	Flexibility of flows, adaptation of protocols	ICU limit, staffing gaps, fragmentation
USA	Decentralised, high-tech	High ICU capacity, developed logistics; prioritisation of risk groups	Wide coverage with remote monitoring	Technological capacity, rapid guidance	Variability of protocols, emergency department overload, vulnerability of psychiatric groups

Table 1. Continued

Cluster	Model type	Resources and routing	Telemedicine	Advantages	Disadvantages
Europe	Hybrid, regional coordination	Resources sufficient but heterogeneous; early stratification	Development, but with regional variability	Inter-level coordination, resilience of primary healthcare	Reduction of elective care, overloads
Asia (excluding China, Japan)	Primary healthcare + public health	Heterogeneous resources; ICU shortages in the periphery	Expanded remote channels	Early routing, integration with public health	Displacement of non-communicable disease services, continuity disruptions
China	Centralised, protocol-oriented	Scaling of oxygen infrastructure, unified stratification	Outpatient/home segment, remote channels	Standardisation, speed of deployment	Overload risks, staff shortage
Japan	Centralised standards + registries	High ICU equipment levels; detailed stratification	Targeted integration	Registry analytics, calibration of protocols	Local overloads, risks of loss of continuity

Source: compiled by the authors as a result of data analysis [17-19,26,40]

The analysis showed that between countries the models for organising care for comorbid patients with COVID-19 exhibited substantial differences in the level of centralisation, resource provision and the degree of integration of chronic patients into the emergency care system. In countries with a strong technological base (USA, Japan), the key advantages were powerful ICUs, developed telemedicine and standardised protocols; however, problems of overload during peak periods and uneven access persisted. In Europe, the strengths were institutionalised coordination and the resilience of primary healthcare, but the weak point remained regional differences in resources and a reduction in elective care at pandemic peaks. In Asian countries (excluding China and Japan) the integration of primary healthcare with public-health systems was significant, whereas the vulnerability of programmes for chronic non-communicable diseases and interruptions in ensuring continuity of follow-up revealed systemic weaknesses. In China, the centralised model with unified algorithms and scaling of oxygen infrastructure provided manageability but increased dependence on human resources. In Kyrgyzstan, the flexibility of organisational flows and adaptation of protocols made it possible to partially compensate for resource shortages; however, limited ICU capacity and staffing reserves remained a key barrier.

There is no universally optimal approach when forming a system of specialised care for comorbid patients with COVID-19: the effectiveness of models is determined by a balance between manageability and flexibility, the baseline level of resource provision and the system's ability to quickly adapt protocols to changing conditions. Centralised systems provide uniformity and speed of deployment but are less flexible for local adaptation; decentralised and hybrid ones adapt better to regional conditions, yet suffer from variability of standards and resource availability. Optimising specialised care requires a combination of clinical-organisational technologies (risk stratification, multidisciplinary teams, telemedicine) with systemic measures to strengthen workforce capacity, infrastructure, and the resilience of channels for managing chronic patients even under peak loads.

Systemic consequences of the COVID-19 pandemic and cross-country recommendations for managing comorbid patients

The COVID-19 pandemic affected the availability, structure, and quality of medical care for chronic patients, especially those with comorbid pathology. Organisational decisions, flow routing and the use of telemedicine influenced outcomes differently depending on the baseline level of resources and the model of the healthcare system. International practice established that the presence of one chronic disease increased the risk of hospitalisation with COVID-19 by 3-5 times and the risk of death by 2.5-4 times compared with people without comorbidity [21].

In the USA, based on information from the large integrated Kaiser Permanente system, in the first wave of the pandemic (April-July 2020) hospitalisations of patients with ≥2 chronic diseases reached 450-500 per 100,000, whereas among those without comorbidity the rate was 80-100 per 100,000 [28,31]. Mortality in this group exceeded 12% with overall in-hospital mortality at 2.5%. Emergency department overload reached 25-30%, but the rapid growth of telemedicine consultations (from 0.2% to 70% of all outpatient visits) made it possible to stabilise in-hospital mortality indicators by the second half of 2020 [30,32].

In Europe, according to a cohort of 66 million residents of France, the presence of multiple chronic diseases increased the risk of COVID-19 hospitalisation by 3.2 times and in-hospital mortality by 2.9 times [34]. In Italy and Spain, mortality among oncological patients with COVID-19 exceeded 25%, with up to 40% receiving delayed treatment [41]. In countries with high provision of ICU beds (Germany, France) the increase in mortality during peak periods was about 20%, whereas under resource shortages it reached 50-60% [34,35]. In Asian countries (excluding China and Japan) the combination of primary healthcare with public health and the use of expanded remote channels provided rapid routing, but at peaks hospitalisations for non-communicable diseases fell by 30-50%, and COVID-19 hospitalisations among comorbid patients doubled [36,38]. Mortality in cardiovascular diseases reached 18-23%, in diabetes 15-20% (with an average level of 4-6%) [37].

In China, the centralised protocol-oriented model with large-scale deployment of oxygen infrastructure and unified risk stratification made it possible to keep in-hospital mortality at 5.5-6% even with high hospitalisation rates [37,39]. The risk of hospitalisation in patients with ≥1 chronic disease was 3.4 times higher, and the risk of death 4.1 times higher than in the general population [38]. The average length of stay increased from 7.5 to 9.1 days, especially in chronic obstructive pulmonary disease and diabetes. A key feature was the rapid repurposing of bed capacity and the transfer of part of functions to outpatient and home segments, which reduced pressure on hospitals during peaks.

In Japan, centralised clinical standards and national registries ensured minimal delays in hospitalisation and detailed in-hospital risk stratification. The combination of several chronic diseases in patients was accompanied by an increased risk of severe COVID-19 by 2.8 times; in severe renal failure, mortality reached 28% [40]. The average length of hospital stay in this group was 30% higher than in the population without comorbidity. In addition, a developed system of multidisciplinary pathways made it possible to maintain the quality of specialised care even with local overloads.

In Kyrgyzstan, with initially limited resources and staffing, flexible repurposing of beds to the respiratory profile and the use of algorithms from vertical programmes (tuberculosis/HIV) partially compensated for the deficit [26,27]. Mortality among severely ill patients with multidrug-resistant tuberculosis and COVID-19 was 34-36%, and with ≥1 concomitant disease the risk of death increased 1.8 times. ICU provision was less than 3 beds per 100,000 population, and oxygen coverage less than 40% of need, which during peak periods led to a sharp increase in mortality. For clarity in comparing differences in outcomes among patients with comorbid conditions depending on resource levels and healthcare organisational models, a summary Table 2 was compiled.

Table 2. Systemic consequences of the COVID-19 pandemic for managing comorbid patients in different countries

Country/Region	Hospitalisation in comorbid (per 100,000)	Relative risk of hospitalisation / death	Mortality (%)	System features (ICU, telemedicine, routing)
Kyrgyzstan	180 (comorbid) vs 100 (without)	Mortality ↑ 1.8 times	34-36 in multidrug-resistant tuberculosis; overall 15-18	ICU <3 per 100,000; oxygen coverage <40%; bed repurposing
USA	450-500 (≥2 diseases) vs 80-100 (without)	Hospitalisation ↑ 5 times; death ↑ 2.5-4 times	12 (overall 2.5)	Emergency overload 25-30%; telemedicine rose from 0.2% to 70% of visits
Europe	320 (with ≥2 diseases) versus 100 (without)	Hospitalisation ↑ 3.2 times; death ↑ 2.9 times	20-25 in oncological patients; up to 50-60 with resource deficits	ICU: 29-34 per 100,000; with overload mortality ↑ 20-60%
Asia (excluding China and Japan)	200-240 (comorbid) vs 100-120 (without)	Hospitalisation ↑ 2 times; death ↑ 2.5-3 times	Cardiovascular 18-23; diabetes 15-20; average 4-6	Reduction of non-communicable hospitalisations by 30-50%; telemedicine widely used
China	340 (≥1 disease) vs 100 (without)	Hospitalisation ↑ 3.4 times; death ↑ 4.1 times	5.5-6	Mass deployment of oxygen infrastructure; centralised routing
Japan	280 (≥2 diseases) vs 100 (without)	Risk of severe course ↑ 2.8 times	28 in severe chronic kidney disease; average 8-10	National registries; multidisciplinary pathways; length of stay ↑ 30%

Note: the symbol "↑" indicates an increase in risk or event frequency

Source: compiled by the authors as a result of data analysis [17-19,26-28,34-41]

The data presented in the Table 2 showed that the presence of comorbid conditions in all countries was accompanied by higher rates of hospitalisation and mortality, with the level of indicators depending substantially on resources and the organisational model of healthcare. In Kyrgyzstan and a number of Asian countries mortality in such patients reached 34-36%, which was explained by limited access to ICU bed capacity and oxygen provision. In Europe and the USA hospitalisations increased 3-5 times, and mortality among certain groups reached 20-25%; however, the introduction of telemedicine and a developed ICU network helped restrain the rise in mortality. In China and Japan, centralised routing and large-scale deployment of oxygen infrastructure made it possible to keep mortality at 5-10% even with high hospitalisation rates. These results confirmed that chronic diseases were a leading factor in adverse outcomes in COVID-19, and the organisational model of the system directly determined the level of hospitalisations and mortality among comorbid patients. Optimising care required combining clinical-organisational technologies (early risk stratification, multidisciplinary teams, telemedicine) with strengthening infrastructure and workforce capacity to ensure resilience even under peak loads.

Based on the cross-country analysis, key directions for improving specialised care for patients with COVID-19 and concomitant diseases were identified, aimed at minimising vulnerabilities revealed in different models. In centralised healthcare systems (China, Japan), which demonstrated high manageability and standardisation, the key direction was to increase protocol flexibility by taking local resource differences into account. To this end it was recommended to pre-specify algorithms for repurposing at least 20% of medical beds to an infectious profile within 72 hours, to form reserve medical teams (1 infectious-disease physician and 2 nurses for every 10 ICU beds), and to introduce a mandatory module for remote monitoring of high-risk patients, allowing a 15-20% reduction in the need for hospitalisations.

In decentralised models (USA), characterised by high adaptability and wide use of telemedicine, the main task remained harmonisation of clinical protocols between regions. It was proposed to introduce unified federal routing standards with specified timeframes for hospital transfer (no more than 48 hours from the onset of symptoms), to create a centralised digital platform for real-time monitoring of ICU occupancy, and to implement systems for early forecasting of hospital load using data from outpatient and emergency tiers, which ensured timely redistribution of resources. Hybrid systems (France, Germany, Italy, Spain, Poland) required strengthening the integration of multidisciplinary teams focused on the management of comorbid patients. Practical measures included institutionalising modular mobile hospitals of 50-100 beds, forming mandatory multidisciplinary groups (cardiologist, endocrinologist, pulmonologist, infectious-disease specialist) for managing severe cases, and introducing a rule for continuity of elective care: maintaining at least 60% of elective operations and consultations even during peak periods by using remote technologies.

In resource-limited countries using adaptive models (Kyrgyzstan, Thailand, Indonesia, India, Malaysia), the priority was to ensure oxygen supply and support the primary tier. Recommendations included repurposing at least 30% of tuberculosis and medical beds to an infectious profile as hospitalisations increased, organising local oxygen-supply stations based on district hospitals (capacity 20-30 cylinders per day), and introducing simplified clinical protocols allowing nursing staff to manage patients with mild and moderate courses. Additionally, training nurses in basic respiratory-support skills (oxygen therapy) within task-shifting technologies was recommended. In all types of systems, it is advisable to strengthen organisational readiness for peak loads through regular stress-testing of care pathways, expansion of data collection on clinical and service indicators broken down by risk groups, and the introduction of inter-sectoral mutual-assistance agreements between regions and institutions. An integral part of the recommendations is the inclusion of comorbid patients in priority groups for proactive monitoring, with an emphasis on cardiovascular, oncological, diabetic and respiratory profiles, which will reduce both in-hospital mortality and the level of exacerbations of chronic diseases under epidemic pressure.

Discussion

The analysis made it possible to establish that differences in organisational models directly affected the resilience of healthcare systems when working with comorbid patients during COVID-19 peak loads. Centralised structures demonstrated high manageability and standardisation of protocols, decentralised and hybrid models – greater technological capacity and adaptability, while resource-constrained systems remained the most vulnerable due to dependence on supplies of oxygen, equipment, and staffing. These features determined both the level of in-hospital mortality and the ability of systems to maintain continuity of care under epidemic pressure.

The combination of several chronic diseases led to a 2-3-fold increase in the risk of severe COVID-19 and death, and with multimorbidity, oncological pathologies and chronic kidney disease the cumulative severity score reached 16 points on a conditional assessment scale. Cardiovascular and chronic respiratory diseases, as well as immunodeficiency conditions, showed scores at the level of 15 points, which reflected a high level of complications, the need for oxygen support and prolonged hospitalisation. These observations correlated with the results presented by R.S. Loungani *et al.* [42], where it was emphasised that pronounced comorbidity was a key predictor of intensive care unit overload and formed a persistent need for multidisciplinary support in the post-hospital period. In the study by P. Adab *et al.* [43] it was similarly indicated that patients with several chronic diseases required priority stratification in clinical pathways and had a higher likelihood of adverse outcomes, which was consistent with the maximum severity values identified in multimorbidity and severe nosologies. According to A.Y. Chang *et al.* [44], the combination of several chronic pathologies increased the risk of prolonged recovery of functional status and raised the frequency of rehospitalisations, which corresponded to the integral severity indicators, especially in groups with combined organ dysfunctions. The analysis by H. Ejaz *et al.* [45] also confirmed that multimorbidity was associated with more severe complications, including multiple organ failure, and required complex treatment protocols; the obtained values of the conditional scale for groups with cardiovascular and respiratory diseases were comparable with the findings. At the same time R. Ashmawy *et al.* [46] focused attention on significant cross-country variability of outcomes due to differences in access to resources and heterogeneity of management protocols, which was reflected in the identified discrepancies between healthcare systems with different models of specialised care.

Centralised models (China, Japan) provided standardisation and manageability but had low flexibility for local adaptation, while decentralised models (USA) were distinguished by technological sophistication and telemedicine with high variability of protocols. Europe's hybrid models combined resilient primary-care channels and coordination but suffered from inter-regional differences and reductions in elective care; integrated primary healthcare models in a number of Asian countries accelerated routing at the risk of interruptions in monitoring chronic patients; and Kyrgyzstan's adaptive model partially offset resource deficits by repurposing beds and redistributing functions. Centralised systems similar to the Chinese and Japanese ones, according to G.M. Katz *et al.* [47], provided high manageability and standardisation of processes but had limited flexibility for local adaptation, which coincided with the identified risks of overload as pressure increased. Decentralised models, as noted by O.V. Kuryata *et al.* [48], were characterised by high technological capacity and active implementation of telemedicine; however, according to comparison with the analysis carried out, both assessments recorded vulnerability to protocol variability and fragmentation of care. Hybrid models described by L. Mahuela *et al.* [49] and characteristic of a number of European countries demonstrated resilient primary-care channels and effective inter-level coordination, which agreed with the advantages reflected in the analysis; however, in both cases a reduction in the availability of elective care during peak loads was noted. Integration of primary healthcare with public health systems, according to S.Y. Tartof *et al.* [50], provided accelerated routing and reduced hospital burdens, which was confirmed by the identified trends, but was accompanied by a risk of interruptions in monitoring chronic patients. Adaptive models under resource constraints, described by E. Driggin *et al.* [51] using Kyrgyzstan as an example, ensured elasticity of flows and the ability to promptly redistribute capacity, which correlated with the results of the analysis; however, in both cases the key limitation of effectiveness was recognised to be shortages of personnel and specialised equipment.

Centralised models (China, Japan) kept mortality among comorbid patients at 5-6%, whereas in resource-constrained systems (Kyrgyzstan) it reached 34-36%. In Asian countries mortality in cardiovascular diseases and endocrine-metabolic disorders was 15-23%, which substantially exceeded average values of 4-6%. The patterns identified correspond to the results of B.Z. Huang *et al.* [52], who showed that the sharp expansion of telemedicine services (from 0.2% to 70% of outpatient visits) in the USA made it possible to stabilise mortality indicators among comorbid patients despite overload of emergency care. The analysis by K.D. Skyrud *et al.* [53] confirmed that even mild COVID-19 could lead to increased use of primary and specialised care for months after illness, which resonates with the identified data on overload of outpatient tiers in hybrid models. Y. Zhou *et al.* [54] showed that obesity and diabetes significantly increased the risk of severe COVID-19, which was consistent with the recorded high mortality (up to 23% in cardiovascular disease and up to 20% in diabetes) in Asian primary healthcare models. Data from O.M Al-Quteimat & A.M. Amer [55] and Z. Bakouny *et al.* [56] on delays and reductions in oncological treatment during the pandemic confirm the identified crowding-out effect on programmes for chronic non-communicable diseases, especially in resource-limited systems.

Centralised systems require flexible adaptation of protocols and expansion of staffing reserves; decentralised systems require unification of standards and centralised monitoring of care. Hybrid models need integration of multidisciplinary teams and reserve channels for elective care, while adaptive ones need provision of oxygen, mechanical ventilation and algorithmisation of processes to compensate for staff shortages. The findings obtained are supported by the results of P. Ssentongo *et al.* [57], who confirmed that prioritisation of vulnerable groups, including people living with HIV, reduces the risk of adverse outcomes under resource constraints, which directly supports the recommendation to include these vulnerable groups in target groups for proactive monitoring. T.J. Cooper *et al.* [58] showed that standardisation of the management of patients with immunodeficiencies and integration of inter-level interaction improve prognosis, which correlates with the task of unifying protocols in decentralised systems. The results of M. Biswas *et al.* [25] on the importance of comprehensive control of comorbid conditions underscore the need for multidisciplinary teams and specialised care channels in hybrid models. The study by S. Elezkurtaj *et al.* [23] on causes of death in hospitalised patients with COVID-19 supports the introduction of regular stress-testing of care pathways for the early identification of vulnerable links. The conclusions of A. Sanyaolu *et al.* [22] on the impact of polycomorbidity on mortality additionally confirm the importance of integrated monitoring and cross-sectoral redistribution of resources during peak periods.

The analysis confirmed that the effectiveness of specialised care for comorbid patients with COVID-19 directly depended on the adaptability of the organisational model and the consistency of clinical protocols. Unification of standards, integration of multidisciplinary teams and development of infrastructure for remote monitoring contributed to relieving hospitals and minimised losses in the quality of care. Prioritisation of vulnerable groups and ensuring a stable supply of critical resources remain key conditions for preventing adverse outcomes. The body of recommendations demonstrates the need for a systemic approach to planning and stress-testing care pathways under epidemic pressure.

Conclusions

The analysis showed that with multimorbidity the cumulative severity score reached 16 points, and with a combination of cardiovascular diseases, chronic respiratory diseases and immunodeficiencies – 15 points. The presence of ≥2 chronic pathologies increased the risk of severe course and fatal outcome by 2-3 times, which underscores the need for early detection, monitoring, and individualisation of care pathways. The international comparative analysis showed that adaptive models under resource constraints (for example, Kyrgyzstan) ensured flexibility of flows and the possibility of repurposing beds, however with oxygen provision below 40% of need and intensive care capacity below 3 beds per 100,000 population, mortality among patients with multidrug-resistant tuberculosis and COVID-19 reached 34-36%. Decentralised high-technology systems (USA) benefit from developed telemedicine and powerful intensive care units; however, with protocol variability and overload of emergency services, mortality among comorbid patients exceeded 12% with overall in-hospital mortality of 2.5%, and the burden on emergency departments reached 25-30%. Hybrid European models are characterised by resilient primary-care coordination, but in peak periods with resource deficits the increase in mortality among comorbid patients reached 50-60%, whereas with high provision of intensive care beds (Germany, France) – about 20%. In Italy and Spain, mortality among oncological patients with COVID-19 exceeded 25% with treatment delayed in 40% of patients.

In Asian countries (Thailand, Singapore, Indonesia, South Korea, India, Malaysia), integration of primary care with public health and remote channels accelerated routing; however, during peaks, hospitalisations for non-communicable diseases fell by 30-50%, and mortality among comorbid patients reached 18-23% for cardiovascular diseases and 15-20% for diabetes. Centralised systems (China, Japan) provide standardisation and manageability through large-scale deployment of oxygen infrastructure and unified risk stratification, which made it possible to keep mortality at 5.5-6% in China and up to 28% in patients with severe renal failure in Japan. Priority measures for different healthcare system models: for centralised – adaptation of protocols and expansion of staffing reserves; for decentralised – unification of standards; for hybrid – integration of multidisciplinary teams; for adaptive – provision of oxygen and mechanical ventilation. These steps will reduce system vulnerability and improve outcomes in patients with a high comorbidity burden. A limitation of this study is the heterogeneity of source data across countries, including differences in methods of recording and classifying comorbid conditions, which may have affected the comparability of results. A promising direction is the conduct of multicentre prospective studies with unified criteria for assessing comorbidity and outcomes, which will make it possible to increase the reliability of cross-country comparisons and develop optimal models of care organisation.

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Conflict of Interest

None.

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Аннотация. Изилдөөнүн максаты коронавирустук инфекция жана өнөкөт оорулары бар бейтаптарга адистештирилген жардамды уюштуруунун өзгөчөлүктөрүн изилдөө жана анын натыйжалуулугун жана жакшыртуу мүмкүнчүлүктөрүн андан ары баалоо болгон. Изилдөө теориялык жана аналитикалык мүнөздө болуп, алты кластерди салыштырууну камтыды: Кыргызстан ресурстары чектелген өлкөнүн үлгүсү катары, Америка Кошмо Штаттары, Европа өлкөлөрү (Франция, Германия, Италия, Испания, Польша), Азия өлкөлөрү (Таиланд, Сингапур, Индонезия, Түштүк Корея, Индия, Малайзия), ошондой эле борборлоштурулган уюм менен Кытай жана Япония. Талдоо 2020-2025-жылдарга жарыяланган басылмаларга, статистикага жана клиникалык көрсөтмөлөргө негизделген; Өлкөлөр аралык салыштыруу коштолгон оорулуулардын оордугуна шарттуу баллдык баа берүү жана жардам көрсөтүүнү жакшыртуу боюнча сунуштарды иштеп чыгуу менен колдонулган. Талдоо көрсөткөндөй, көп оорулуулар менен оордуктун индекси 16 баллга жеткен, ал эми жүрөк-кан тамыр, респиратордук оорулар жана иммундук жетишсиздик менен – 15. Эки же андан көп өнөкөт патологиялар оор агымдын жана өлүмдүн коркунучун 2-3 эсеге жогорулаткан. Кытайда жана Японияда ооруканадагы өлүм 5,5-6 % түздү, Японияда бөйрөктүн оор жетишсиздиги менен – 28 % га чейин. Америка Кошмо Штаттарында бир нече өнөкөт оорулары менен ооругандардын өлүмү 12 % дан ашты, жалпысынан 2,5 %, тез жардам бөлүмдөрүндөгү жүк 25-30 % га жетти. Европада эң жогорку мезгилдерде өлүмдүн өсүшү болжол менен 20 % ды түздү, ресурстардын жетишсиздиги менен – 50-60 % га чейин, Италияда жана Испанияда рак менен ооругандардын арасында – 25 % дан ашык. Кыргызстанда кургак учуктун көп дары-дармектерге туруктуулугу менен бул көрсөткүч 34-36 % га жетти. Алынган маалыматтар тобокелдикти стратификациялоону, протоколдорду адаптациялоону жана адам ресурстарын жана инфраструктуралык потенциалды чыңдоону талап кылган кошумча оорулардын оордугунан жана саламаттык сактоо ресурстарынан көз карандылыгын тастыктайт. Натыйжалар саламаттыкты сактоо органдары жана медициналык мекемелер тарабынан коронавирус инфекциясы жана өнөкөт оорулары бар бейтаптарга жардам көрсөтүүнү оптималдаштыруу үчүн колдонсо болот

Негизги сөздөр: ооруканага жаткыруу; өлүм; багыттоо; тобокелдик стратификациясы; кычкылтек терапиясы; телемедицина; көп тармактуу команда

Система оказания специализированной медицинской помощи при Covid-19 с коморбидными заболеваниями

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Аннотация. Цель исследования заключалась в изучении особенностей организации специализированной помощи больным коронавирусной инфекцией и хроническими заболеваниями с последующей оценкой её результативности и возможностей улучшения. Исследование имело теоретико-аналитический характер и включало сравнение шести кластеров: Кыргызстан как пример страны с ограниченными ресурсами, США, государства Европы (Франция, Германия, Италия, Испания, Польша), страны Азии (Таиланд, Сингапур, Индонезия, Южная Корея, Индия, Малайзия), а также Китай и Япония с их централизованными моделями организации. Анализ базировался на публикациях, статистике и клинических рекомендациях 2020-2025 гг.; применялось межстрановое сопоставление с условной балльной оценкой тяжести у коморбидных пациентов и разработкой рекомендаций по совершенствованию помощи. Анализ показал, что при мультиморбидности показатель тяжести достигал 16 баллов, а при сердечно-сосудистых, респираторных заболеваниях и иммунодефицитах – 15. Две и более хронические патологии увеличивали риск тяжёлого течения и смерти в 2-3 раза. В Китае и Японии госпитальная летальность составляла 5,5-6 %, при тяжёлой почечной недостаточности в Японии – до 28 %. В США смертность у пациентов с несколькими хроническими болезнями превышала 12 % при общей 2.5 %, нагрузка на отделения неотложной помощи достигала 25-30 %. В Европе рост смертности в пиковые периоды составлял около 20 %, при дефиците ресурсов – до 50-60 %, среди онкологических больных в Италии и Испании – более 25 %. В Кыргызстане при мультирезистентном туберкулёзе показатель достигал 34-36 %. Полученные данные подтверждают зависимость исходов от тяжести сопутствующих заболеваний и ресурсов здравоохранения, что требует стратификации риска, адаптации протоколов и укрепления кадрового и инфраструктурного потенциала. Результаты могут быть использованы органами здравоохранения и медицинскими учреждениями для оптимизации помощи пациентам с коронавирусной инфекцией и хроническими заболеваниями

Ключевые слова: госпитализация; летальность; маршрутизация; стратификация риска; кислородная терапия; телемедицина; мультидисциплинарная команда