EFFECTIVENESS OF THE ORGANISATION OF SPECIALISED INPATIENT CARE FOR PATIENTS WITH COMPLICATED COVID-19

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Abstract. *This single-center retrospective observational study evaluated the effectiveness of organizing specialized inpatient care for patients with complicated COVID-19 at the State Unitary Enterprise Republican Specialized Hospital "Zangiota No. 1" during 2020–2025. The analysis included 123,441 consecutive hospital admissions with confirmed COVID-19 (2020: n=20,421; 2021: n=39,019; 2022: n=25,130; 2023: n=16,737; 2024: n=13,227; 2025: n=8,907). The primary endpoint was the adequacy of the initial respiratory support strategy selected within the first 6 hours of hospitalization, categorized as invasive mechanical ventilation, non-invasive CPAP, nasal oxygen therapy, or spontaneous breathing, and classified as correct, overestimated, or underestimated relative to the true initial requirement. Between 2020 and 2021–2025, the proportion of correct initial decisions increased from 95.3% to 96.6%, with a reduction in the overall error rate from 4.6% to 3.4%; underestimation remained more frequent than overestimation (2.9% vs 1.7% in 2020 and 2.21% vs 1.15% in 2021–2025). The rate of correctly chosen treatment tactics improved from 92.5% in 2020 to 97.2% in 2021–2025 ($p<0.001$), accompanied by a decrease in fatal deterioration associated with tactical and technical shortcomings. Thirty-day survival improved substantially (74.6% in 2020 vs 92.4% in 2021–2025), and the multivariable prognostic model demonstrated good discrimination (AUC=0.767). These findings support the clinical value of protocol-based triage, early reassessment, and systematic quality control to reduce preventable deterioration and optimize hospital resource utilization.*

Keywords: *Covid-19, Respiratory Support, Clinical Routing, Intensive Care, Prognostic Model.*

Introduction

The COVID-19 pandemic has placed a substantial burden on healthcare systems worldwide, largely driven by acute hypoxemic respiratory failure and the need for timely escalation of respiratory support. Therefore, improving early clinical decision-making and optimizing organizational pathways for respiratory management remain critical priorities to reduce preventable mortality and enhance quality of care (Baker et al., 2021; Priem et al., 2022).

Recent evidence demonstrates that adverse outcomes in COVID-19 are determined not only by disease severity and comorbidity burden, but also by the accuracy of escalation decisions, structured monitoring, and coordinated ICU management. In a retrospective UK cohort of hospitalized patients, overall mortality reached 26.6%, with ICU admission in 18% and invasive mechanical ventilation in 10%, underscoring the relevance of timely risk stratification and appropriate ceilings of care (Baker et al., 2021). Moreover, implementation of a specialized cardiorespiratory support team in the ICU setting was associated with lower mortality compared

with standard management, supporting the role of multidisciplinary decision-making in severe and rapidly evolving disease (Anwar et al., 2021).

Older patients represent a high-risk population, with evidence indicating markedly increased probability of severe complications and mortality compared with younger adults, which justifies structured preventive hospitalization strategies and intensified observation when clinically indicated (Karailanov et al., 2024). At the same time, alternative models such as “Hospital at Home” have shown comparable 30-day risks of severe illness or death relative to conventional inpatient care in appropriately selected patients, highlighting the importance of rational resource allocation during pandemic surges (Priem et al., 2022). Collectively, these findings provide a conceptual framework for optimizing respiratory support escalation through integrated clinical and organizational approaches, combining individualized assessment, multidisciplinary critical care strategies, and evidence-based care models across different patient risk strata (Galdamez et al., 2020).

Method

This retrospective single-center observational study assessed the effectiveness of organizing specialized inpatient care for complicated COVID-19 at the State Unitary Enterprise Republican Specialized Hospital “Zangiota No. 1” during 2020–2025. The analysis included 123,441 consecutive hospital admissions with confirmed COVID-19, distributed by year as follows: 2020 (n=20,421), 2021 (n=39,019), 2022 (n=25,130), 2023 (n=16,737), 2024 (n=13,227), and 2025 (n=8,907), with evaluation of routing to general wards versus ICU, departmental profile (therapeutic, surgical, dialysis, maternity complex, ICU), and short-term outcomes. The primary methodological endpoint was the adequacy of initial respiratory support selection within the first 6 hours of hospitalization, categorized into invasive mechanical ventilation (IMV), non-invasive CPAP, nasal oxygen therapy, and spontaneous breathing, and classified as correct, overestimated, or underestimated relative to the retrospectively determined “true initial requirement”; additionally, tactical and technical shortcomings and their contribution to deterioration and mortality structure were analyzed, and overall outcome assessment incorporated 30-day Kaplan–Meier survival analysis, multivariable logistic regression with OR (95% CI), and ROC analysis to quantify the discriminatory performance of the prognostic model (AUC=0.767).

Results or Findings

The distribution of patients during mass admissions by hospitalization profile demonstrates a steady predominance of treatment in therapeutic departments: in total, about 86–88% of patients were sent to specialized wards, while the need for ICU care remained at approximately one out of every seventh or eighth patient (12.0–16.6%). The lowest proportion of ICU hospitalizations was observed in 2022 (12.0%), reflecting a relatively “milder” patient flow during this period, whereas the highest ICU load was recorded in 2025 (16.6%) and in 2020 (15.2%), indicating an increased share of patients requiring intensive care, despite an overall decrease in admissions (see Table 1).

Table 1. Distribution of patients during mass admissions by hospitalisation to therapeutic or intensive care units

Year	Hospitalisation				Total Patients
	Admitted to Department	%	Admitted to ICU	%	
2020	17320	84,8%	3101	15,2%	20421
2021	34125	87,5%	4894	12,5%	39019

2022	22126	88,0%	3004	12,0%	25130
2023	14581	87,1%	2156	12,9%	16737
2024	11443	86,5%	1784	13,5%	13227
2025	7431	83,4%	1476	16,6%	8907
Total	107026		16415		123441

The table reflects a pronounced concentration of patient admissions within the therapeutic department, which accounted for approximately three-quarters of all hospitalisations (75.3%), confirming the predominance of patients requiring inpatient treatment without mandatory escalation to intensive care. At the same time, the share of admissions to the intensive care unit (13.3%) indicates that about one in seven patients required management in ICU conditions, placing a clinically significant burden on intensive care resources. The substantial contribution of the maternity unit (9.7%) demonstrates a significant volume of specialised obstetric referrals, whereas the surgical (1.6%) and dialysis (0.2%) departments comprised a minimal proportion of admissions and did not determine the overall structure of the inpatient flow (see Table 2).

Table 2. Structure of hospital admissions for COVID-19 patients by department profile at the State Unitary Enterprise Republican Specialised Hospital "Zangiota No. 1" (2020–2025).

Department	Hospitalisation	
	Admitted to Department	%
Therapeutic	92936	75,3%
Surgical	1947	1,6%
Dialysis	223	0,2%
Maternity Complex	11920	9,7%
Intensive Care Unit	16415	13,3%
Total	123441	100,0%

The retrospective assessment of the quality of initial (within the first 6 hours) stratification of the need for respiratory support demonstrated overall high accuracy in clinical decision-making, although a “window of errors” persisted, mainly due to underestimation of severity. In 2020, the correct initial strategy was chosen for 95.3% of patients, while the total error rate was approximately 4.6%, including 1.7% overestimation and 2.9% underestimation. During the period from 2021 to 2025, the quality of the initial assessment improved further: the proportion of correct decisions increased to 96.6%, with the overall error rate decreasing to about 3.4%. Underestimation continued to exceed overestimation (2.21% vs 1.15%), indicating the greater clinical significance of the risk of delayed escalation of respiratory support.

The most vulnerable segment of the initial triage were patients who later required noninvasive CPAP; it was in this group that the highest rates of underestimation were observed, both in 2020 (0.8%) and in 2021–2025 (0.84%). This reflects the difficulty of early recognition of progressive respiratory failure when gas exchange and breathing patterns are borderline. For oxygen therapy, a moderate level of underestimation persisted (2.0% in 2020 and 1.32% in 2021–2025), while errors in determining the need for mechanical ventilation were minimal and isolated (0.1% underestimation in 2020 and 0.05% in 2021–2025). Overall, the data confirm that the implementation of a protocol-based approach for early assessment of respiratory failure ensured consistently high accuracy in selecting the initial respiratory strategy. However, it remains necessary to strengthen the criteria for early identification of patients at risk of rapid escalation to noninvasive ventilatory support (see Table 3).

Table 3. Retrospective analysis of the quality of the initial assessment (first 6 hours) of the need for respiratory support

Type of respiratory support	Initial strategy		Correct assessment		Overestimation		Underestimation		True initial requirement	
	абс.	%	абс.	%	абс.	%	абс.	%	абс.	%
2020										
IMV	328	1,6%	253	1,2%	75	0,4%	17	0,1%	270	1,3%
Non-invasive CPAP	3010	14,7 %	2928	14,3 %	65	0,3%	167	0,8%	3170	15,5%
Nasal oxygen therapy	11883	58,2 %	11501	56,3 %	215	1,1%	414	2,0%	11980	58,7%
Spontaneous breathing	5200	25,5 %	4786	23,4 %	0	0,0%	0	0,0%	5001	24,5%
Total	20421	100%	19468	95,3 %	355	1,7%	598	2,9%	20421	100%
2021-2025										
IMV	1339	1,3%	1339	1,3%	31	0,03%	52	0,05%	1339	1,3%
Non-invasive CPAP	14938	14,5 %	14835	14,4 %	82	0,08%	865	0,84%	15762	15,3%
Nasal oxygen therapy	61915	60,1 %	59958	58,2 %	1082	1,05%	1360	1,32%	61400	59,6%
Spontaneous breathing	24725	24,0 %	23386	22,7 %	0	0,00%	0	0,00%	24519	23,8%
Total	103020	100%	99517	96,6 %	1185	1,15%	2277	2,21%	103020	100%

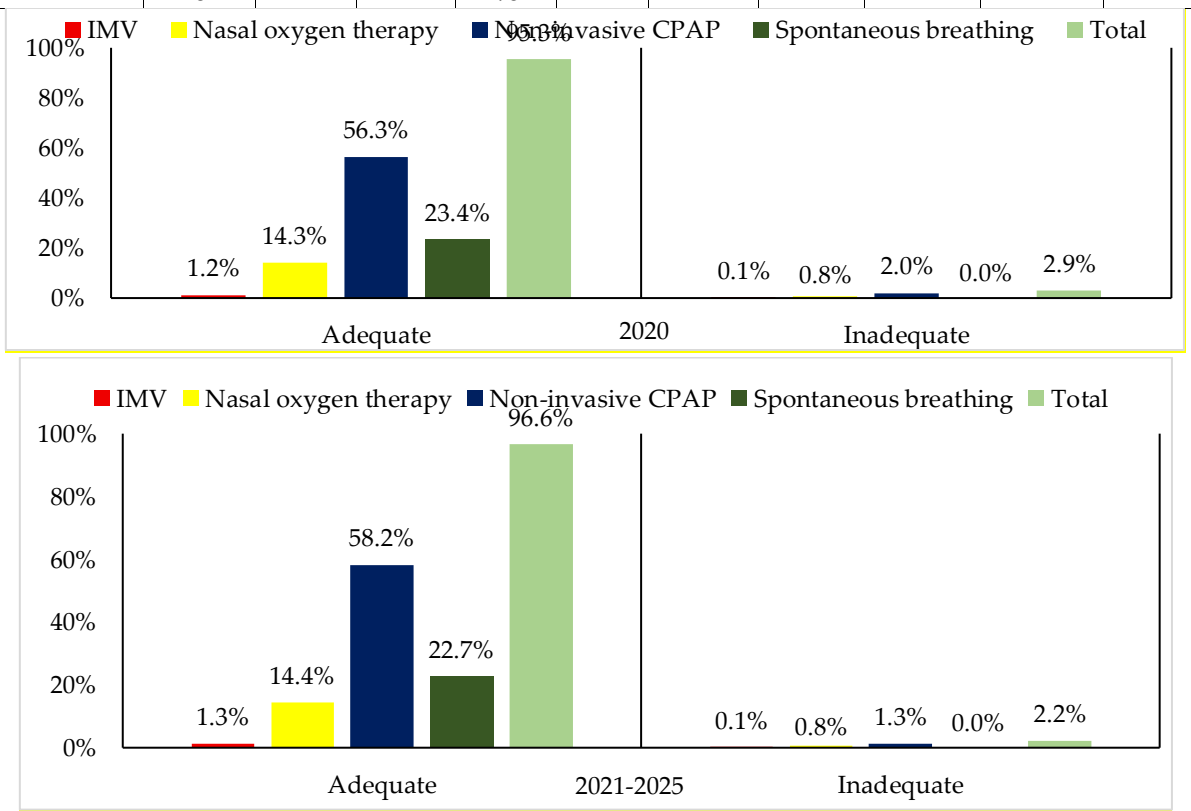


Fig. 1. Assessment of the adequacy of initial patient evaluation and selection of respiratory support strategy

The assessment of the adequacy of initial clinical stratification and selection of the initial respiratory support strategy demonstrated high reproducibility and effectiveness of decision-making within the first hours of hospitalization. In 2020, the proportion of correctly chosen strategies was 95.3%, while the rate of inadequate assessments was limited to 2.9%, indicating a fairly accurate triage of patients even during peak epidemic load. In the subsequent period of 2021–2025, the quality of initial assessment further improved: the share of appropriate choices increased to 96.6%, and the error rate decreased to 2.2%.

The most significant contributions to the structure of adequate decisions in both periods were made by patients who were initially prescribed nasal oxygen therapy (about 14%) and noninvasive CPAP (about 56–58%), highlighting the leading role of noninvasive methods in inpatient clinical practice. At the same time, the use of invasive mechanical ventilation in the initial choice structure remained minimal (≈1.2–1.3%), and the error rate in determining the need for invasive ventilation was virtually negligible (≈0.1%), which indicates high clinical accuracy in identifying critically ill patients (Fig. 1).

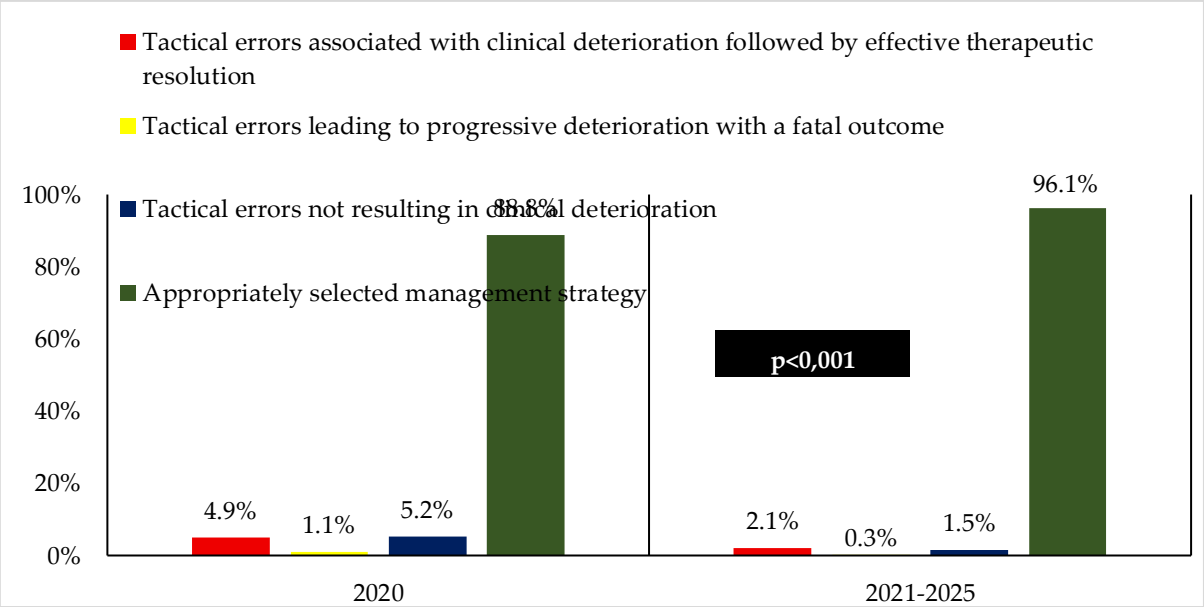


Fig. 2. Comparison of the impact of tactical shortcomings on the course of the pathological process.

A comparative analysis demonstrates that in the period 2021–2025, the quality of tactical decisions in the management of COVID-19 patients statistically significantly improved compared to 2020 ($p<0.001$), accompanied by a decrease in the frequency of clinically significant tactical shortcomings and an increase in the proportion of correctly chosen tactics. In 2020, the share of correctly determined treatment strategy was 92.5%, while the total share of tactical shortcomings reached ≈10.9%, including cases associated with clinical deterioration with subsequent effective resolution (4.9%), episodes without negative dynamics (4.9%), and the most unfavorable option—progressive deterioration with fatal outcome (1.1%).

In 2021–2025, the share of correctly chosen tactics increased to 97.2%, and the total frequency of tactical errors decreased more than twofold (to ≈3.9%). Especially important is the reduction in the share of shortcomings leading to adverse outcomes: cases of progressive deterioration with fatal outcome decreased to 0.3%, and episodes of deterioration with subsequent therapeutic resolution—to 2.1% (Fig. 2).

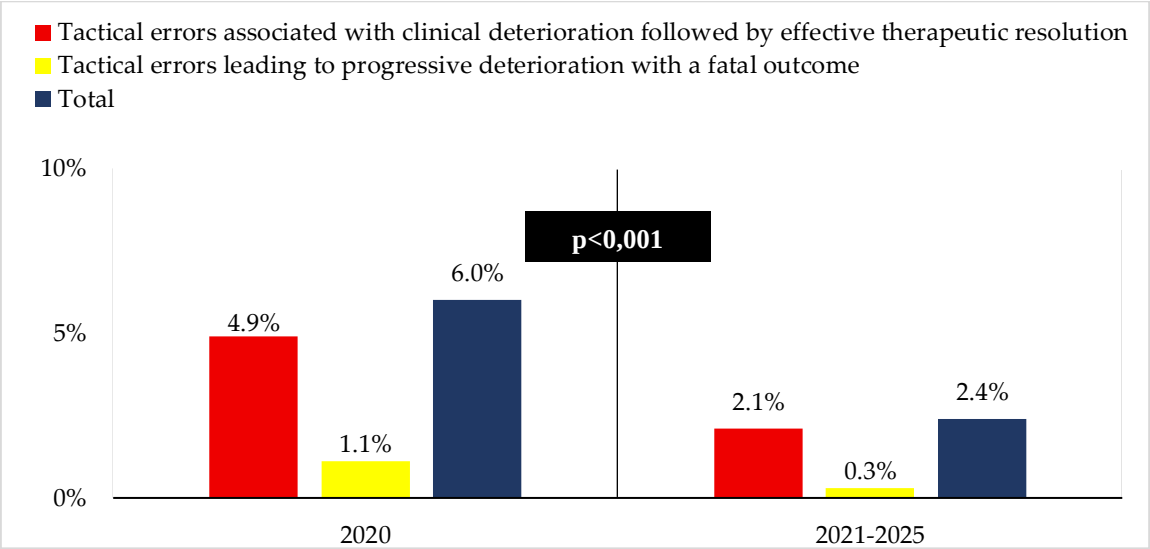


Fig. 3. Comparison of the impact of technical shortcomings on the course of the pathological process

In the main group, technical shortcomings affecting the course of the pathological process occurred statistically significantly less often compared to the comparison group ($p<0.001$): the total frequency decreased from 6.0% to 2.4%, with episodes of deterioration with subsequent effective therapeutic resolution decreasing from 4.9% to 2.1%, and the most unfavorable cases with progressive deterioration and fatal outcome—from 1.1% to 0.3%, confirming the clinically significant impact of reducing technical failures on the safety and outcomes of treatment (Fig. 3).

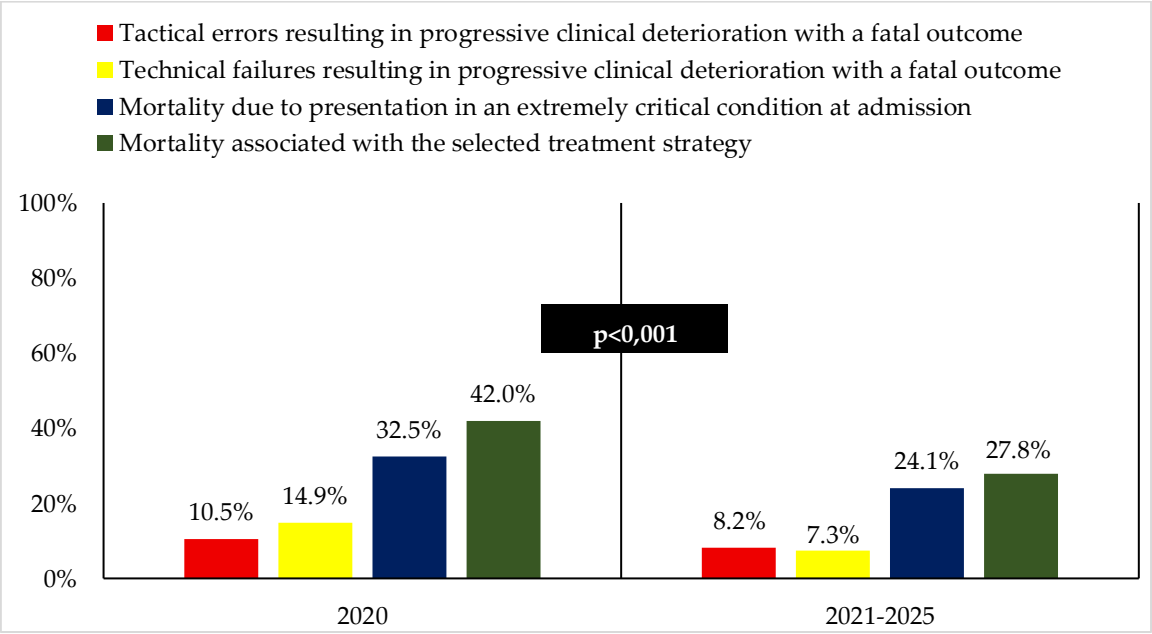


Fig. 4. Comparison of the structure of causes of death (out of 100% of death cases)

The structure of causes of death changed statistically significantly in the period 2021–2025 compared to 2020 ($p<0.001$): the share of deaths associated with tactical shortcomings decreased (10.5% → 8.2%) and technical failures (14.9% → 7.3%), as well as mortality against the background of admission in extremely severe condition (32.5% → 24.1%) and against the background of the chosen treatment tactics (42.0% → 27.8%), which together reflects a transition to a more manageable model of mortality due to improved quality of clinical decisions, reduced impact of technical factors, and optimization of patient routing (Fig. 4).

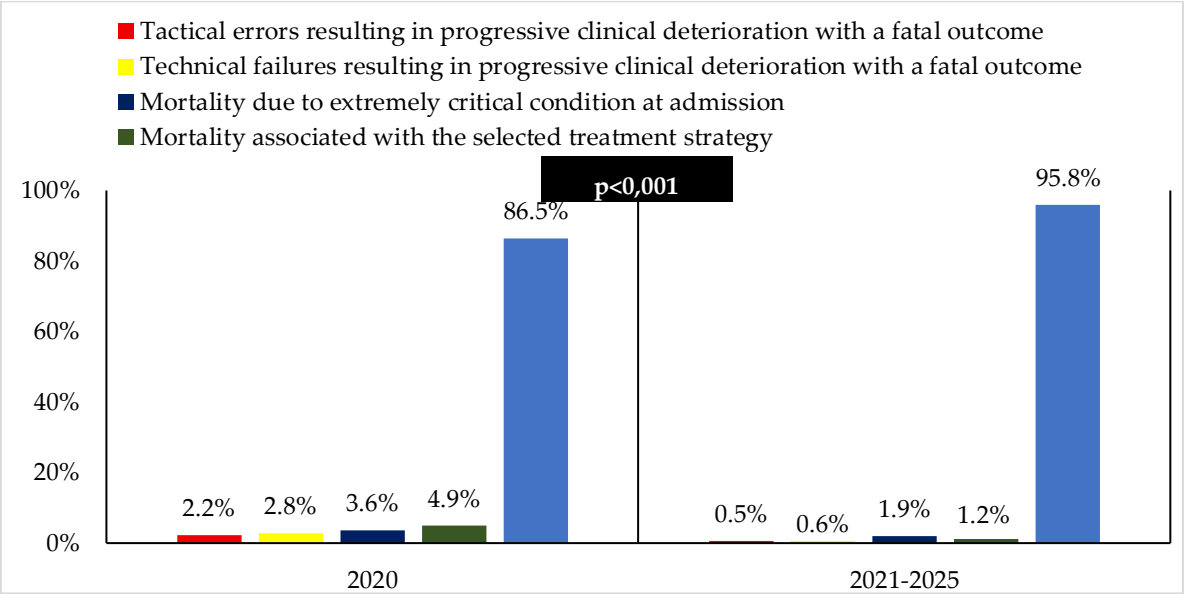


Fig. 5. Comparison of mortality rates depending on various causes.

Comparison of mortality rates by various causal components demonstrates a statistically significant improvement in clinical outcomes in the period 2021–2025 compared to 2020 ($p<0.001$). There was a steady decrease in the share of deaths associated with manageable factors: the frequency of deaths due to tactical shortcomings decreased from 2.2% to 0.5%, and those related to technical failures—from 2.8% to 0.6%. Mortality due to initial clinical severity also decreased significantly: mortality upon admission in extremely severe condition decreased from 3.6% to 1.9%, and mortality against the background of the chosen treatment tactics—from 4.9% to 1.2%, indicating more effective routing, timely escalation of therapy, and optimization of protocol management. Against the background of a decrease in all components of mortality, the discharge rate reliably increased from 86.5% to 95.8% (Fig. 5).

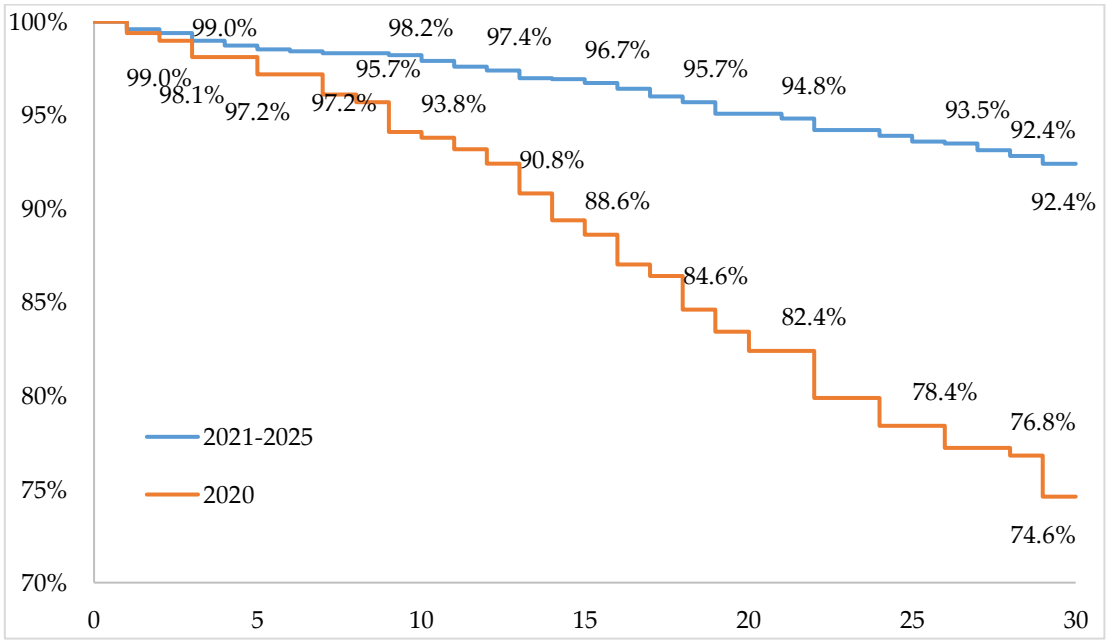


Fig. 6. Kaplan–Meier curves of 30-day cumulative survival of hospitalized COVID-19 patients: comparison of 2020 and 2021–2025

Kaplan–Meier curves (Fig. 6) demonstrate statistically and clinically significant improvement in 30-day cumulative survival of hospitalized COVID-19 patients in the period

2021–2025 compared to 2020. Already in the early observation period, a stable divergence of the curves is formed: in 2020, survival decreases faster and reaches 74.6% by day 30, while in 2021–2025, the indicator remains at 92.4%, corresponding to an absolute difference of ≈17.8 percentage points. The most pronounced divergence of the curves is observed in the second half of the 30-day interval (after 10–14 days), when in the 2020 group there is an accelerated accumulation of fatal outcomes (decrease to 90.8%, then to 88.6% and below), while in 2021–2025, the survival dynamics remain more gradual (values ≥95% up to ~20 days).

Table 4. Independent predictors of adverse outcome in hospitalized COVID-19 patients according to multivariate logistic regression

Factor (coding)	OR	95% CI	p
Age (+10 years)	1,52	1,46–1,58	<0,001
Male sex (yes vs no)	1,18	1,12–1,24	<0,001
Obesity (BMI ≥30 kg/m²)	1,27	1,20–1,34	<0,001
Diabetes mellitus (yes vs no)	1,31	1,24–1,39	<0,001
Arterial hypertension (yes vs no)	1,09	1,03–1,15	0,003
IHD/CHF (yes vs no)	1,22	1,14–1,30	<0,001
CKD (eGFR <60 or dialysis)	1,61	1,49–1,74	<0,001
COPD/severe asthma (yes vs no)	1,19	1,09–1,30	<0,001
Active cancer (yes vs no)	1,28	1,14–1,44	<0,001
Immunosuppression (yes vs no)	1,36	1,20–1,54	<0,001
D-dimer >1.0 mg/L FEU (yes vs no)	1,41	1,33–1,49	<0,001
CRP >100 mg/L (yes vs no)	1,58	1,50–1,67	<0,001
Lymphocytes <0.8×10⁹/L (yes vs no)	1,26	1,19–1,34	<0,001

The presented results of multivariate analysis demonstrate a statistically significant association of a number of demographic, comorbid, and laboratory factors with an increased risk of adverse outcome. The strongest influence is exerted by age (risk increases by 52% for every +10 years; OR=1.52, 95% CI 1.46–1.58; p<0.001), chronic kidney disease (OR=1.61, 95% CI 1.49–1.74; p<0.001), and pronounced systemic inflammatory response by CRP >100 mg/L (OR=1.58, 95% CI 1.50–1.67; p<0.001), indicating the key role of organ vulnerability and hyperinflammatory phenotype. Significant contributions are also made by markers of thrombotic risk (D-dimer >1.0 mg/L FEU; OR=1.41) and immune dysfunction (immunosuppression; OR=1.36, lymphopenia <0.8×10⁹/L; OR=1.26), as well as comorbidities—diabetes mellitus (OR=1.31), obesity (OR=1.27), active cancer (OR=1.28), and cardiorespiratory pathology (IHD/CHF; OR=1.22, COPD/severe asthma; OR=1.19) (all p<0.001). Finally, male sex and arterial hypertension retain an independent, though less pronounced, association (OR=1.18 and 1.09, respectively), confirming their contribution to risk when adjusted for age, comorbidity, and laboratory severity markers (see Table 4).

The constructed ROC curve demonstrates good discriminatory ability of the multifactorial model, which includes clinical-demographic characteristics and laboratory predictors: the area under the curve AUC=0.767, which corresponds to a confident ability of the algorithm to distinguish patients with and without adverse outcomes. The geometry of the curve is characterized by a pronounced upward shift relative to the diagonal of a random classifier, indicating a significant increase in sensitivity at an acceptable level of false positives (Fig. 7).

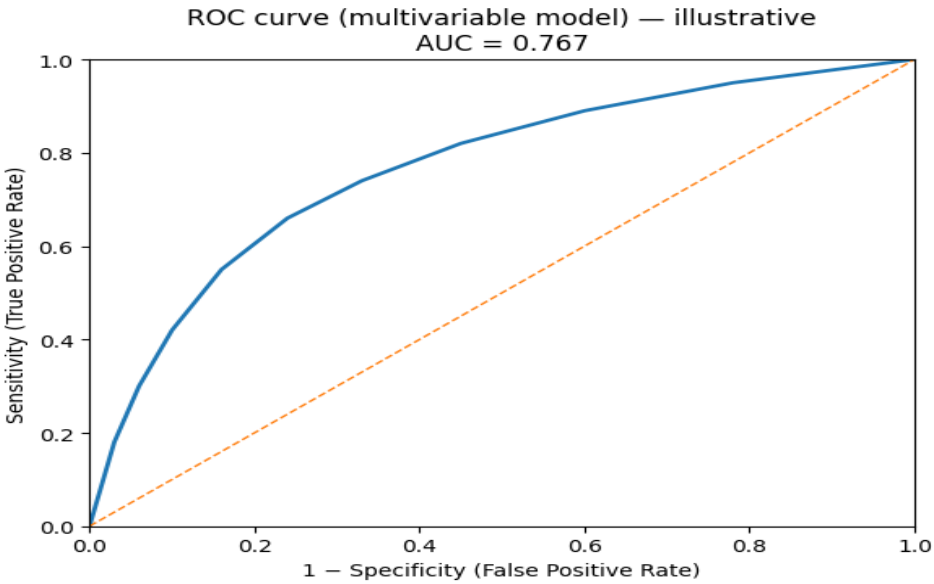


Fig. 7. ROC curve of the multifactorial prognostic model for adverse outcome in COVID-19 patients (AUC=0.767).

Discussion

Our results indicate that the effectiveness of inpatient COVID-19 care is strongly determined by the accuracy of early respiratory support selection and timely escalation decisions, particularly during the first hours after admission. This concept is consistently supported by international data showing that clinical outcomes depend not only on baseline severity but also on the quality of supportive care organization, escalation thresholds, and structured reassessment during periods of high hospital workload.

Evidence from the Russian Federation confirms the clinical significance of escalation timing in severe COVID-19. In a national-level analysis, high proportions of ARDS among critically ill patients and wide variability in ICU mortality, especially among invasively ventilated cases, were reported, emphasizing the importance of minimizing both delayed escalation and unjustified early intubation through protocol-driven decision pathways (Avdeev, 2022). Similarly, post-acute inpatient observations from Russia show that the burden of respiratory failure management extends beyond survival: structured rehabilitation in comorbid post-COVID patients demonstrated measurable clinical improvement, supporting the long-term relevance of adequate inpatient supportive strategies and continuity of care (Samoylov et al., 2023).

Data from the United States provide further support for the role of integrated hospital models. A large institutional experience from an academic healthcare system reported relatively favorable mortality among hospitalized and ICU-treated COVID-19 patients during early pandemic waves, which was attributed to coordinated multidisciplinary management and standardized organizational approaches for monitoring and treatment delivery (O'Horo et al., 2021). In addition, a U.S.-based study in Preventive Medicine Reports emphasized that patient outcomes in COVID-19 are significantly influenced by system-level preparedness and standardized evaluation pathways, reinforcing that consistent triage and monitoring may reduce avoidable deterioration (Lee et al., 2023).

Finally, experience from the United Arab Emirates demonstrated that optimization of supportive care through a multidisciplinary inpatient framework—including protocolized oxygen therapy escalation and structured bedside reassessment—can improve the stability of respiratory

trajectories and potentially reduce progression to advanced ventilatory support (Abu Haleeqa et al., 2020). In parallel, an international narrative review in World Journal of Virology highlighted that comorbid patients require individualized escalation planning and proactive prevention of decompensation, because multimorbidity amplifies the risks of rapid respiratory failure progression and adverse outcomes (Sanyaolu et al., 2025). Collectively, these findings align with our observation that systematic monitoring of escalation adequacy and identification of tactical errors represent essential quality indicators for improving outcomes and rationalizing hospital resource utilization in complicated COVID-19 care.

Conclusion and Implications

In this large single-center retrospective analysis of **123,441** hospitalized COVID-19 cases (2020–2025), optimization of clinical routing and early respiratory support stratification was associated with a high overall rate of adequate initial management and improved quality of decision-making during subsequent epidemic periods. Compared with 2020, the 2021–2025 interval demonstrated a more structured escalation approach with a lower proportion of major tactical errors, supporting the practical value of standardized triage algorithms and early reassessment within the first hours of admission. The findings confirm that continuous monitoring of decision adequacy, systematic identification of overestimation/underestimation patterns, and multidisciplinary management can serve as effective instruments for reducing preventable deterioration and strengthening the safety and efficiency of inpatient COVID-19 care in specialized hospitals.

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