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COVID-19: A Local Report on Patients in the Covid Ward in Bytom, Poland

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Abstract: The objective of this study was to characterize the clinical profile, laboratory findings, treatment strategies, and outcomes of patients hospitalized with COVID-19 at the Department and Clinic of Internal Medicine, Angiology and Physical Medicine in Bytom, Poland, during the period from December 2021 to March 2022. A total of 120 adult patients with confirmed SARS-CoV-2 infection were retrospectively analyzed. Data included demographic information, vaccination status, comorbidities, laboratory biomarkers (CRP, IL-6, D-dimer), treatment modalities (including antibiotics, corticosteroids, anticoagulants, antivirals, and immunomodulators), and in-hospital mortality. Statistical analysis was performed using ANOVA, with significance set at $p < 0.05$. Most patients were over 75 years old and had multiple comorbidities such as hypertension (57.5%), diabetes (40.8%), and respiratory diseases (22.5%). Only 37% were vaccinated. The overall in-hospital mortality was 19%, including 9 vaccinated individuals. Elevated levels of CRP (mean: 90.44 mg/L in females, 115.98 mg/L in males), IL-6 (up to 1319 pg/mL), and D-dimers (up to 32.94 mg/L) were observed, correlating with disease severity. Ceftriaxone was the most used antibiotic (84% of patients), while dexamethasone and LMWH were standard treatments. Tocilizumab was used selectively in patients with IL-6 > 100 pg/mL. Older age, lack of vaccination, and comorbidities were major risk factors for severe COVID-19. High values of CRP, D-dimer, and IL-6 were consistent with a worse prognosis, aligning with international findings. Corticosteroids and anticoagulants were widely used and clinically justified, while the routine use of antibiotics such as ceftriaxone may not be supported by current evidence. These results underscore the importance of evidence-based treatment protocols and biomarker-guided risk stratification in managing hospitalized COVID-19 patients.

Keywords: SARS-CoV-2 virus; COVID 19; risk factors; treatment; respiratory system diseases

1. Introduction

1.1. COVID-19 pandemic.

In March 2020, COVID-19 was declared a global pandemic [1,2]. The case fatality rate in China was 2.3%, while in Italy it was more than three times higher (7.2%), likely due to demographic differences [3]. In both countries, the infection mainly affected people over 65 years of age. Human coronaviruses had been known for a long time, but were associated only with mild illness. This changed with the emergence of SARS-CoV-1 in 2002, which had a significantly higher case fatality rate (7%) than previously known human coronaviruses. Another coronavirus that had a global impact was Middle East respiratory syndrome coronavirus (MERS-CoV) [4], which showed less virulence but a significantly higher case fatality rate (34.4%) [5]. In 2025, COVID-19 remains a chronic, albeit more controlled, global health problem. Due in part to broad protection from vaccination and prior infection, the virus originating from Omicron lineage variants, such as FL.1.5.1, remains extremely contagious but typically causes less severe symptoms [6–8]. The disease continues to pose a significant threat to vulnerable groups such as the elderly, those with comorbidities, and those with weakened immune systems [9–11]. Public health initiatives remain largely focused on vaccination campaigns, and new vaccines tailored to the latest variants are now widely available [12]. To minimize the spread of long-term COVID-19, which continues to affect millions of people with debilitating symptoms such as chronic fatigue, brain fog, and cardiovascular problems, and to prevent severe outcomes and hospitalizations, these new formulations are essential [13,14]. Because vaccine immunity is known to wane after several months, public health officials emphasize the importance of booster doses, especially for high-risk populations [15,16]. Meanwhile, emergency measures have given way to long-term management plans in the global response to the epidemic. Testing and local containment measures remain in place in many countries, with a particular emphasis on high-risk settings such as medical facilities [17]. Although some treatments are facing challenges as new variants evade previous measures, the development of advanced antiviral drugs and monoclonal antibody therapies continues [18]. Current public health policies balance epidemic management with the protection of daily life, avoiding the mass lockdowns of the past. Improved public air quality, such as improved ventilation and HEPA filtration, is now essential to limiting viral spread, particularly in workplaces, schools, and transportation systems [19,20]. However, gaps in healthcare resources and vaccine availability remain between high- and low-income countries, making some areas more susceptible to outbreaks and severe disease [21,22]. Global organizations are working to bridge these gaps, but financial and logistical obstacles remain. COVID-19 continues to burden healthcare systems worldwide, not only through acute cases but also through the long-term impact of prolonged COVID, motivating extensive research into its causes and treatments [23]. To combat the virus's ongoing evolution, scientists are using artificial intelligence to predict viral changes, assess treatment effectiveness, and improve vaccine development [24,25]. All things considered, COVID-19 remains a serious threat requiring continued attention, adaptation, and creativity, even though it is no longer as disruptive a force as it was in 2020–2021 [26]. To cope with this new phase of the pandemic, public health initiatives are now emphasizing responsible living with the virus, encouraging both individual and collective actions, including vaccination, wearing masks in crowded areas, and improving health infrastructure [27]. The development of the COVID-19 pandemic has highlighted the increase in the number of pandemic-related diseases, such as diabetes,

cardiovascular diseases, obesity, chronic lung diseases, neurodegenerative diseases, etc., which increase the risk of mortality and hospitalization in people with COVID-19 [28,29]. The role of adiponectin (APN) has been shown to be crucial in viral infections, regulating the immune response through the anti-inflammatory/pro-inflammatory axis. A reduction in APN concentration may exacerbate the course of viral infections, as APN suppresses the immune response by inhibiting inflammatory signaling pathways and stimulating adenosine monophosphate-activated protein kinase (AMPK) [30]. The COVID-19 pandemic has created a need for effective drugs. Two of the drugs described in the work by Negru *et al*. [31] are favipiravir (FVP) and remdesivir (RDV), which are used in the treatment of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection. Medical data from relevant literature and authorized clinical trials highlight the importance of better understanding the interactions between drug molecules and infectious agents to improve global treatment of COVID-19 patients and reduce the risk of antiviral drug resistance [31].

1.2. Coronavirus (CoV) structure.

The first cases of a new, previously unknown coronavirus were detected in December 2019 in Hubei Province, China. Isolation of the virus causing this pneumonia and its analysis revealed that it was a new species of coronavirus (CoV), previously unknown worldwide, and difficult to eradicate from the outset [32]. This CoV was initially given the working name 2019-nCov, and on February 11, 2020, its official name was announced: Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). The World Health Organization (WHO) named the disease Coronavirus disease 2019 (COVID-19) [33]. The name of this family of viruses is closely related to their structure, as their outer shell contains an envelope composed of the E protein, the envelope protein responsible for virion assembly, and the M protein, a membrane protein that forms the viral matrix. From this envelope, extend projections composed of the S fusion protein, which binds receptors on attacked cells; in the case of SARS-CoV-2, this is angiotensin-converting enzyme 2 (ACE2) (Figure 1) [34]. Coronaviruses are spherical in shape and small, ranging from 80 to 180 nm. Inside these viruses is the N protein, a nucleocapsid protein that protects the single-stranded RNA nucleic material [35–38]. The coronavirus family consists of four subgroups: alpha (α), beta (β), gamma (γ), and delta (δ) coronaviruses [39]. Of these, only alpha and beta coronaviruses are responsible for human infections. Alpha coronaviruses include HCoV-NL63 and HCoV-229E, while other HCoV types, HCoV-OC43, HCoV-HKU1, SARS-CoV, MERS-CoV, and the most recent SARS-CoV-2, belong to the beta coronaviruses. Of these seven viruses, three are zoonotic. SARS-CoV and MERS-CoV originate from bats but were transmitted by other mammals, civet cats and camels, respectively. Phylogenetic comparisons of SARS-CoV-2 with other coronaviruses have shown that bats may also be the virus's native host. However, the intermediate host of the virus is not fully known; it is suspected that a mammal from the pangolin family may be involved [40]. The Omikron variant of the SARS-CoV-2 genome contains approximately 18–261 mutations, of which approximately 97% occur in the coding region and the remaining 558 in the non-coding region [41]. Mutations in this variant of the SARS-CoV-2 coronavirus increase infectivity and may make the virus more resistant to the human immune system. The precise relationship between the mutations present in the Omikron variant and their health consequences is still the subject of intensive research. Due to the short time since the first case of infection with this pathogen, many uncertainties remain regarding the course of COVID-19 disease caused by the Omikron variant [42].

Another example is the Alpha variant, which spreads much faster than the SARS-CoV-2 from China, and people infected with it are at a higher risk of severe disease and death. Infections are rare among fully vaccinated individuals [43]. Another variant is the Delta variant, which is also highly contagious. This strain is estimated to be 97% or 100% more infectious than the original epidemic strain. The case fatality rate for the Delta strain is nearly 0.3%, compared to 1.9% for the Alpha strain. This lower rate is due to vaccination reducing the case fatality rate of the Delta variant [44].

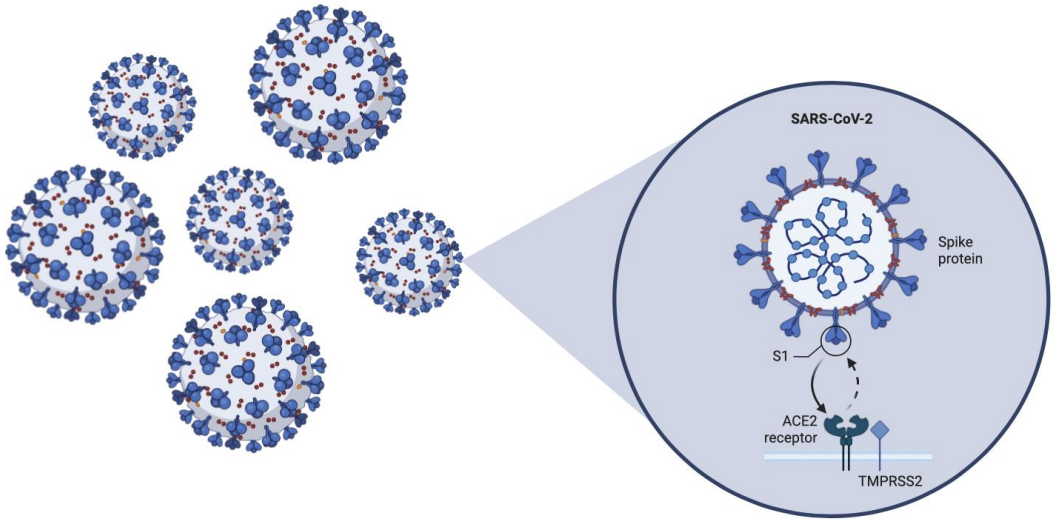

Figure 1. Coronavirus structure.

The aim of this work is to characterize patients hospitalized in the Department and Clinic of Internal Medicine, Angiology, and Physical Medicine in Bytom during the period from December 2021 to March 2022 with coronavirus disease. Analysis of epidemiology, prevention, and pharmacological treatment in patients with COVID-19 infection based on data collected from 120 patients.

2. Materials and Methods

From December 2021 to March 2022, the Covid Ward of the Clinic of Internal Diseases, Angiology and Physical Medicine in Bytom treated 120 patients (58 male/62 female) with varying degrees of COVID-19 infection (Table 1). The treatment was carried out according to the recommendations for the diagnosis and therapy of SARS-CoV-2 infections of the Polish Society of Epidemiologists and Doctors of Infectious Diseases (PTEiLChZ 13.10.2020). Patients with full-blown severe respiratory failure were admitted to the COVID Ward (grade 2 and 3 according to PTEiLChZ). Results are expressed as the mean ± S.D. The statistical significance of differences between the groups was determined by applying an ANOVA. Values of $p<0.05$ were considered statistically significant.

Table 1. Characteristics of 120 patients.

Characteristic	***n* total = 120**
Sex – no [%]	
Male	48.3%
Female	51.7%
Race or ethnic group [%]	
White	96.7%
Not reported	3.3%
Age group [%]	
18-65 y/o	31.7%
66-75 y/o	28.3%

Characteristic	*n* total = 120
75 y/o	40%
COVID-19 vaccine	
Yes	37%
No	63%
Comorbidities	
Diabetes	40.8%
Hypertension	57.5%
Respiratory system disease	22.5%
Obesity	16.7%
Other	94.2%

The study involved 120 patients, of whom 48.3% were men and 51.7% were women, indicating an even gender distribution in the analyzed group. Most of the participants were Caucasian, as many as 96.7%, while ethnic data was not reported in 3.3% of cases. In terms of age, patients were divided into three groups: 31.7% were between 18 and 65 years old, 28.3% were between 66 and 75 years old, and the largest group, 40%, were patients over 75 years old. As for COVID-19 vaccination status, 37% of patients were vaccinated, while 63% had not been vaccinated. Numerous comorbidities were reported among patients. Diabetes was present in 40.8% of the study participants, hypertension in 57.5%, respiratory diseases in 22.5%, and obesity in 16.7%. In addition, as many as 94.2% of patients had other conditions not listed in the table. The study included only patients who met specific inclusion criteria (Table 2). These were: first-time diagnosis of COVID-19, no previous history of treatment for this disease, age over 18, and the fact that the main reason for hospitalization was COVID-19 infection. The study also included graphs showing the distribution of vaccinations among patients (Figure 2), the types of vaccines used (Figure 3), and the number of doses received by vaccinated individuals (Figure 4). Although these data were not presented in detail in the tables, they complement the analysis and provide additional information on COVID-19 prevention in this group.

Table 2. Inclusion criteria.

	Inclusion criteria
1.	First-time diagnosis of COVID-19
2.	No previous treatment history
3.	Age above 18y/o
4.	The main reason for hospitalization is COVID-19

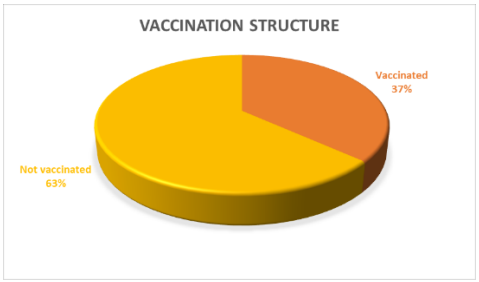

Figure 2. Vaccination [%].

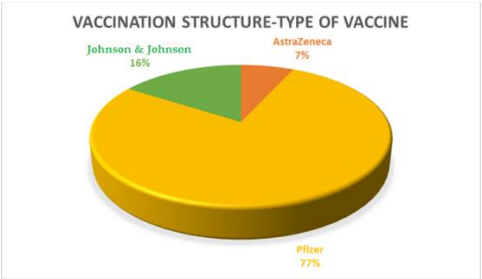

Figure 3. Type of vaccine.

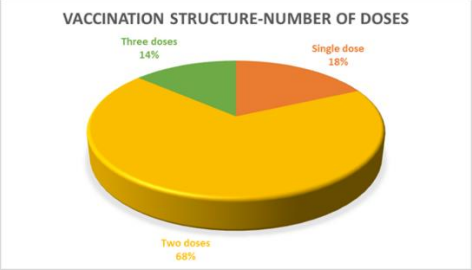

Figure 4. Number of vaccine doses.

3. Results and Discussion

All treatment and selected parameters of laboratory tests (CRP, D-dimer, IL-6), including patients who died because of COVID-19 infections in our department, are presented in Table 3 for females and Table 4 for males.

Table 3. Characteristics of female patients treated for COVID-19 in the Department and Clinic of Internal Diseases, Angiology and Physical Medicine in Bytom, Poland.

Laboratory tests			Treatment					Vaccinations**	Deaths
CRP [mg/l]	IL-6 [pg/ml]	D-dimers [mg/l]	Dexaven	Antibiotic*	LMWH	Veklury	RoActemra		
339.55	N/A	0.777	+	1	+	-	-	2P	-
9.64	N/A	0.674	+	1	+	-	-	2P	-
443.99	N/A	0.459	+	1	+	-	-	0	-
94.37	N/A	2.862	+	1	+	-	-	0	-
1.51	N/A	0.788	+	1	+	+	-	0	-
4.48	N/A	1.780	+	1	+	+	-	2P	-
69.82	N/A	0.379	+	1	+	+	-	0	-
28.77	35.2	0.733	+	1	+	+	-	0	-
168.03	5.3	0.578	+	1	+	-	-	0	-
9.49	N/A	0.573	+	1	+	+	-	1JJ	-
42.58	N/A	1.047	+	1	+	+	-	0	-
107.10	N/A	0.683	+	1	+	-	-	0	-
427.96	N/A	2.487	+	1	+	-	-	2P	-
11.86	N/A	0.412	+	1	+	-	-	0	-
112.97	N/A	1.968	+	1	+	+	-	0	-
159.92	N/A	0.941	+	1	+	+	-	0	-
70.48	N/A	4.118	+	1	+	-	-	0	-
29.89	N/A	0.547	+	1	+	-	-	0	-
50.16	N/A	1.935	+	1	+	-	-	1JJ	-
60.06	N/A	2.778	+	-	+	-	-	2P	-
55.81	N/A	3.626	+	1,3	+	-	-	0	-
75.10	N/A	0.893	+	1	+	+	-	0	-
176.58	167.1	0.348	+	1	+	-	+	0	-
79.62	N/A	0.998	+	1	+	-	-	1P	-
47.57	N/A	0.761	+	1	+	+	-	0	-
74.34	N/A	N/A	-	-	-	-	-	2AZ	-
6.73	10.8	2.478	-	1	+	-	-	2P	-
7.59	N/A	0.783	+	1	+	-	-	2P	-
113.02	N/A	0.361	+	1	+	-	-	2P	-
59.48	N/A	0.630	-	1	+	-	-	0	-
38.42	N/A	0.330	-	1	+	-	-	0	-
58.40	25.3	0.888	+	1	+	+	-	0	-
29.67	N/A	0.757	+	1	+	-	-	0	-
408.32	N/A	0.982	+	1,3	+	-	-	2P	-
63.19	11.6	1.490	+	1	+	-	-	0	-
1.90	7.6	0.836	+	1	+	+	-	0	-
255.01	162.4	19.325	+	1	+	-	+	0	-
67.37	29.8	1.792	+	1	+	-	-	0	-
122.30	N/A	2.220	+	1	+	-	-	2P	-
73.78	8.6	0.912	+	2,5	+	-	-	2P	-
44.12	25.9	1.373	+	1	+	+	-	0	-
65.44	46.0	1.453	-	1	+	-	-	0	-

Laboratory tests			Treatment					Vaccinations**	Deaths
CRP [mg/l]	IL-6 [pg/ml]	D-dimers [mg/l]	Dexaven	Antibiotic*	LMWH	Veklury	RoActemra		
3.23	N/A	0.440	+	1	-	-	-	0	-
45.78	N/A	0.675	+	1	+	-	-	0	-
86.70	12.9	0.302	+	1	+	+	-	0	-
77.84	5.2	1.798	+	1	+	-	-	0	-
56.89	N/A	3.367	-	1	+	+	-	2P	-
18.96	N/A	0.364	+	1	+	-	-	0	-
295.49	N/A	7.586	+	3	+	+	-	0	-
99.98	N/A	0.576	+	-	+	-	-	0	-
1.03	N/A	0.276	-	-	+	-	-	3P	-
60.80	1319.0	32.940	+	1	+	-	+	2P	-
75.51	50.0	0.836	+	1	+	+	-	0	-
30.48	14.4	0.250	+	-	+	+	-	0	-
151.33	N/A	0.771	+	1	+	-	+	0	+
45.79	N/A	0.675	+	1	+	-	-	0	+
150.41	N/A	1.129	+	1	+	-	-	2P	+
236.93	N/A	N/A	+	1	+	-	-	0	+
30.48	14.04	0.250	-	-	+	+	-	0	+
75.5	50.0	0.836	+	1	+	+	-	0	+
60.80	1319.0	32.940	+	1,4	+	-	+	2P	+
0.491	33.6	1.630	+	1,3,4	+	+	-	0	+
16.31	N/A	1.489	+	1	+	-	-	0	+
01.01	N/A	0.180	+	1	+	-	-	2P	+

* Antibiotic: 1 Ceftriaxone; 2 Cefuroxime; 3 Meropenem; 4 Vancomycin; 5 Clrarithromycin; 6 Ciprofloxacinum; 7 Amoxicillinum+Acidum clavulanicum; ** Vaccinations: AZ AstraZeneca; P Pfizer; JJ Johnson & Johnson; 1 -single dose; 2 -two doses; 3- three N/A Not applicable.

Table 4. Characteristics of male patients treated for COVID-19 in the Department and Clinic of Internal Diseases, Angiology and Physical Medicine in Bytom, Poland.

Laboratory tests			Treatment					Vaccinations**	Deaths
CRP [mg/l]	IL-6 [pg/ml]	D-dimers [mg/l]	Dexaven	Antibiotic*	LMWH	Veklury	RoActemra		
315.45	N/A	8.907	+	1	+	+	-	0	-
37.85	9.3	0.359	+	1	+	-	-	0	-
69.77	N/A	1.828	+	1	+	+	-	0	-
111.01	N/A	5.811	-	2	+	-	-	2AZ	-
117.24	N/A	0.367	+	1	-	-	-	2P	-
172.22	N/A	3.559	+	1	+	+	-	2P	-
108.00	N/A	17.248	+	1	+	-	-	0	-
12.91	N/A	0.735	+	1	+	-	-	2AZ	-
116.61	18.2	1.168	+	1,3	+	+	-	0	-
73.31	N/A	0.697	+	1	+	-	-	0	-
66.13	N/A	0.574	+	1	+	-	-	0	-
15.04	N/A	0.704	+	1	+	-	-	1JJ	-
163.83	N/A	0.586	+	1	+	-	-	2P	-
5.36	N/A	0.499	+	1	+	+	-	0	-
135.54	N/A	9.879	+	1	+	-	-	0	-
159.92	N/A	0.941	+	1	+	+	-	0	-
127.14	N/A	0.376	-	1	+	-	-	0	-
40.54	N/A	1.732	+	1	+	+	-	2P	-
258.78	N/A	1.564	+	1	+	-	-	0	-
123.13	N/A	0.359	-	1	+	-	-	2P	-
11.69	14.8	0.251	-	-	-	-	-	0	-
248.60	18.9	1.392	+	1,3	-	+	-	2P	-
15.72	N/A	0.917	+	1,4	+	-	-	0	-
39.05	N/A	2.130	-	5	+	-	-	0	-
174.63	N/A	1.137	+	1	+	+	-	1JJ	-
22.89	N/A	1.330	+	1	+	+	-	0	-
67.14	N/A	2.032	+	1	+	-	-	2P	-
231.49	1097.0	1.708	+	1	-	+	+	3P	-
108.00	99.6	1.308	+	1	+	-	-	0	-
10.29	8.6	2.946	-	2	+	-	-	1JJ	-
95.31	N/A	N/A	-	6	+	-	-	3P	-

Laboratory tests			Treatment					Vaccinations**	Deaths
CRP [mg/l]	IL-6 [pg/ml]	D-dimers [mg/l]	Dexaven	Antibiotic*	LMWH	Veklury	RoActemra		
32.61	N/A	1.760	+	1	-	-	-	3P	-
73.78	8.6	0.912	+	2,5	+	-	-	2P	-
19.53	N/A	2.369	+	1	+	+	-	0	-
220.50	N/A	1.061	+	1	+	-	-	0	-
65.44	46.0	1.453	-	1	+	-	-	0	-
50.39	N/A	0.553	+	1	+	-	-	0	-
207.30	285.3	1.073	+	1	+	+	+	0	-
19.46	N/A	0.830	+	1,7	+	-	-	0	-
144.79	N/A	8.530	+	1	+	-	-	0	-
110.25	465.6	0.586	+	1	+	+	+	0	-
5.26	N/A	0.820	+	4	-	-	-	0	-
493.34	215.9	7.714	+	1	+	+	-	0	-
80.38	N/A	0.893	+	-	+	-	-	2P	-
11.08	15.9	0.714	+	1	+	+	-	2P	-
179.20	N/A	0.870	+	1	+	-	-	1JJ	+
424.0	116.1	11.088	+	1	+	-	-	0	+
163.0	80.8	0.458	+	1	+	+	-	0	+
41.53	N/A	2.010	+	1	+	-	-	0	+
425.42	433.0	8.062	+	3	+	-	+	0	+
82.65	340.8	0.945	+	1	+	+	-	0	+
80.83	N/A	1.710	-	-	+	-	-	2P	+
11.01	15.08	0.714	+	1	+	-	-	2P	+
129.93	N/A	N/A	-	1	+	-	-	0	+
26.71	N/A	N/A	+	4	-	-	-	3P	+
145.35	N/A	N/A	-	3,7	-	-	-	0	+
20.29	N/A	N/A	-	1	-	-	-	3P	+
208.21	N/A	N/A	+	1	+	-	-	1JJ	+

* Antibiotic: 1 Ceftriaxone; 2 Cefuroxime; 3 Meropenem; 4 Vancomycin; 5 Clrarithromycin; 6 Ciprofloxacinum; 7 Amoxicillinum+Acidum clavulanicum; ** Vaccinations: AZ AstraZeneca; P Pfizer; JJ Johnson & Johnson; 1 -single dose; 2 -two doses; 3- three N/A Not applicable.

Dexaven was used almost universally in females, but notably less in males. LMWH (low molecular weight heparin), used for anticoagulation, was significantly more common in females. RoActemra, an IL-6 receptor blocker, was used more often in males — consistent with their higher IL-6 levels. Antibiotics were widely used in both groups. Veklury (remdesivir) had low usage overall. The presence of one or more risk factors was observed in almost all patients: diabetes mellitus (40%), hypertension (58%), respiratory diseases (32%), obesity (16%), and old age (58%). One out of 120 patients had no aggravating factors at admission. Ninety-three percent of patients received antibiotic therapy due to bacterial superinfection. Eighty-four percent of patients were treated with ceftriaxone. In patients with stage 3 infections (SpO_2 <90%, usually 2 weeks of disease), the level of IL-6 was determined to start treatment with tocilizumab (IL-6>100 pg/ml). All patients received anticoagulants. Low-molecular-weight heparin (LMWH) was predominant in prophylactic or therapeutic doses. Patients who did not receive LMWH typically used NOAC or vitamin K antagonists for other medical conditions. Jabłońska *et al*. [46] examined the real-life impact of vaccination on COVID-19 mortality in Europe and Israel. The analysis revealed that the COVID vaccine reduced COVID-related deaths by 72% in infected individuals [45]. Among our patients who died from COVID-19, 9 were vaccinated, and the overall mortality rate was 19%. Forty percent of affected men were vaccinated vs. 34% of affected women. The most popular COVID-19 vaccine was Pfizer, chosen by 77% of patients, and most received two doses (68%). The chart below (Figure 5) shows the percentage of deaths among vaccinated and unvaccinated patients with COVID-19. Of 120 patients, about 63% were not vaccinated against COVID-19. Of the

37% vaccinated, 7% of patients chose AstraZeneca, 16% of patients chose Johnson & Johnson, and 77% Pfizer.

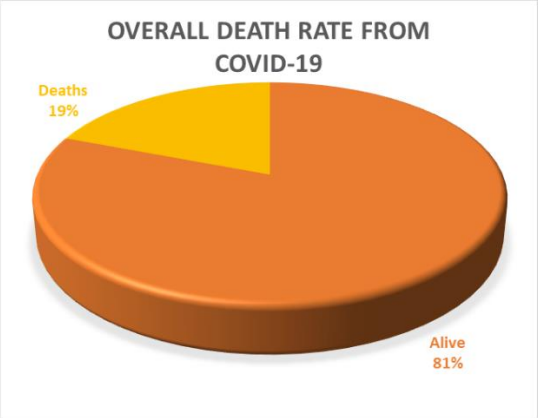

Figure 5. Morbidity and mortality by age group of hospitalized patients.

Males had higher average CRP levels (115.98 mg/l) than females (90.44 mg/l) (Table 5). Both genders showed a wide range and high standard deviation, indicating variability in inflammatory response (Figure 6). For D-dimers, average levels were comparable between genders, but females had higher maximum values, suggesting more extreme thrombotic activity in some cases. Males had dramatically elevated IL-6 (mean = 213.04 pg/ml) compared to females (mean = 13.50 pg/ml). This suggests males experienced more intense cytokine responses, possibly linked to severe disease or complications. Males demonstrated stronger inflammatory and immune responses (especially in IL-6), potentially correlating with more severe disease outcomes. Females had wider variability in D-dimer levels, suggesting a subgroup with thrombotic risk. CRP levels were slightly higher on average in males, but with a large spread (SD > 100), and the difference was not statistically significant. IL-6 levels were dramatically higher in males, indicating a much stronger cytokine response. This difference was statistically significant ($p < 0.001$). D-dimers were nearly identical in both sexes on average; no significant difference was found, although females showed more extreme outliers (max = 32.94).

Table 5. Laboratory test results.

Parameter	Females (n=64)	Males (n=58)	p-value (ANOVA)
CRP [mg/l]	90.44 ± 102.61	115.98 ± 108.18	0.18
D-dimers [mg/l]	13.50 ± 9.79	213.04 ± 327.43	<0.001
IL-6 [pg/ml]	2.57 ± 6.16	2.46 ± 3.41	0.94

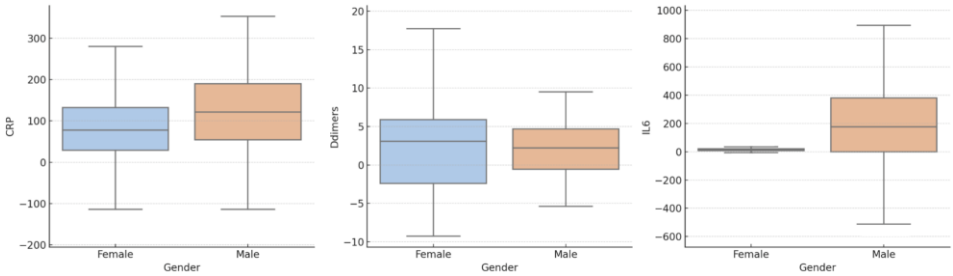

Figure 6. CRP, D-dimers, and IL-6 results.

3.1. Discussion.

Research has confirmed the association between age and COVID-19 outcomes, highlighting that age remains a significant factor in determining the severity of the condition

[46]. The risk of serious illness, hospitalization, and death is much higher for older persons, especially those 65 and older. Higher rates of comorbidities (such as diabetes, hypertension, and cardiovascular diseases), immunosenescence (the immune system's natural deterioration with age), and a heightened inflammatory response known as a "cytokine storm," which is more common in older people during severe infections, are all factors contributing to this increased vulnerability [47,48]. Observations and research on infections with the new coronavirus show that people of all ages, including children and the elderly, are affected. However, pediatric patients are much less likely to experience severe disease. It is these patients who usually have asymptomatic or mildly symptomatic disease. Most occurrences are mild to asymptomatic, and children and young adults are typically less likely to experience catastrophic effects. Young individuals are not completely immune to major difficulties. Although they are uncommon, disorders like multisystem inflammatory syndrome (MIS-C) can occur in pediatric populations [49,50]. There are cases where COVID-19 in children requires hospitalization, even in the intensive care unit, but this is much less than in other older age groups. The main symptoms observed in pediatric patients due to SARS-CoV-2 infection are fever, cough, and upper respiratory tract irritation. Due to coronavirus disease, respiratory failure occurs in the most severe cases, but in children, it is often caused by causes other than COVID-19. Given the mild or asymptomatic course of the disease in the youngest, it cannot be ruled out that they may be virus carriers to a large extent. This is not the case with adults, and especially with older people. Much more often than children, they have a more severe or even fatal infection with SARS-CoV-2. It is not conclusively demonstrated that older people are more likely to become infected, but studies show that the death rate in people over 70 is much higher. The overall death rate in China was around 2.3% at the start of the COVID-19 pandemic. In people over 70, it reaches 8%, and among patients who are over 80, this indicator reaches over 14%. In Italy, in the group of ninety-year-olds, this indicator was as high as 22%. Such data show that the older people are, the greater the risk that they will pass the infection severely, and the incidence of COVID-19 may be fatal in elderly patients more often than in young people. Probably the more frequent severe course of coronavirus disease in the elderly is also associated with the fact that they suffer from various chronic diseases, which weakens their immunity [51-53]. Reducing age-related differences in results has been made possible in large part by vaccination. All age groups benefit from updated immunizations tailored to the most recent variants, with older adults and those with weakened immune systems given priority in booster programs [54,55]. Compared to their contemporaries who are not vaccinated, older persons who receive booster shots have much lower risks of hospitalization and mortality, according to research. These results highlight the necessity of ongoing monitoring, immunization campaigns, and age-appropriate approaches to address the immediate and long-term effects of COVID-19 [56,57]. COVID-19 and respiratory system disorders are significantly correlated. It has been demonstrated that COVID-19 can worsen pre-existing respiratory diseases such as asthma and chronic obstructive pulmonary disease (COPD), frequently resulting in more severe disease outcomes. Additionally, research shows that those who had poor respiratory health before contracting COVID-19 are more likely to be hospitalized and experience long-term issues such as persistent lung inflammation or fibrosis [58,59]. These conditions tend to worsen during viral infections and are often seen with previously known coronaviruses, as well as other viruses that affect the respiratory system. Numerous studies have been conducted on this subject in various regions of the world, and appropriate relationships have been drawn. In cases where COVID-19 has affected people with asthma and other allergic diseases, no significant

association has been found in adults between these respiratory diseases and a severe course of coronavirus disease. Asthma and allergic diseases exacerbate the course of COVID-19 in young people [60]. Additionally, respiratory symptoms like dyspnea (shortness of breath), persistent coughing, and decreased lung function are often included in protracted COVID-19 symptoms (also known as "long COVID"), which can last for months or even years after infection [61]. For COPD, the question of increased infection risk and COVID-19 severity is somewhat different. ACE2 activity is increased in the epithelial tissue lining the bronchi and lungs of patients with COPD. This is the receptor through which the SARS-CoV-2 virus binds to and attacks human cells. This may mean that COPD patients are more likely to become infected with the coronavirus, and their disease is not necessarily mild. People suffering from COPD have a weak respiratory system even before being infected with SARS-CoV-2 and are very susceptible to various types of respiratory diseases. The research shows that only 2.8% of the group of people with both COVID-19 and COPD survived [28]. Hypertension is the most common comorbid condition among patients infected with SARS-CoV-2. According to studies, people who already have high blood pressure are more likely to experience serious consequences from COVID-19, such as hospitalization and death [62]. Research and meta-analyses show that it negatively affects the course of the disease and is a risk factor for more severe COVID-19. Patients with hypertension are more than 2 times more susceptible than patients without additional diseases. The SARS-CoV-2 virus attaches to the ACE-2 receptor on the cell surface, and physiologically, ACE-2 receptors are involved in the conversion of angiotensin II to angiotensin 1-7. Angiotensin 1-7, on the other hand, reduces blood pressure. This relationship among the virus, the ACE-2 receptor, and the blood pressure control system may influence the link between hypertension and COVID-19. Hypertension is a disease that the elderly often suffer from. This has led some experts to question the disease as a risk factor, saying that the severity of COVID-19 is only related to age. Such theses, however, are often not supported by current research, which indicates that hypertension is associated with a higher risk of severe coronavirus disease [63]. Additionally, about 21% of hospitalized patients acquire chronic high blood pressure, which has been associated with SARS-CoV-2 infection and new-onset hypertension. Compared to similar respiratory diseases like influenza, this risk is larger. This trend is made worse by variables like age, obesity, stress, and the drugs taken to treat COVID-19, which can lead to long-term cardiovascular problems [64]. Obesity, diabetes, and the severity of COVID-19 results are strongly correlated. Type 2 diabetes is linked to systemic inflammation, a compromised immune system, and prior vascular damage; it is a major risk factor [62]. HbA1c readings ≥7% suggest that a patient's blood glucose is poorly controlled, making them at a heightened risk of severe illness, intensive care unit (ICU) admission, and increased mortality [65]. Furthermore, obesity (classified as a BMI ≥30 kg/m^2) increases these chances by causing respiratory mechanics problems and a pro-inflammatory condition, both of which worsen COVID-19 symptoms [66]. Diabetes mellitus is a common comorbidity that often accompanies coronavirus infection. Data from the Chinese control center showed that among patients who had diabetes and became infected with the SARS-CoV-2 virus, the mortality rate was three times higher than in those who did not have comorbidities. In people with diabetes, such a poor prognosis may be caused by many factors. Often associated with obesity, diabetes makes the patient's body prone to inflammation as the levels of inflammatory mediators increase, and this can trigger the release of mediators known as a "cytokine storm," resulting in severe disease and death. Another factor may be the presence of microvascular complications of the disease in diabetic patients. It is also suspected that the

severe course of COVID-19 may also be influenced by the hypercoagulability associated with diabetes. Hypercoagulability is partially regulated by glycemic control and viral infection via a cytokine storm that acts as a procoagulant, increasing hypercoagulability. Hypoglycemia can also have an effect on inflammation, so it is important to control your blood glucose levels. Inflammation increases insulin resistance, which can be important and disturbing for glucose regulation. Studies have also shown that the coronavirus can damage pancreatic beta cells because they contain an active ACE2 receptor [67,68]. Both variables independently increase vulnerability and severity, according to me-ta-analyses and machine learning studies. For example, poor glycemic control and high triglyceride-glucose (TyG) indices were strongly positively correlated with COVID-19 vulnerability in diabetic individuals [69]. Because obesity deteriorates outcomes like oxygen saturation and recovery rates, it has also been proven to increase hazards, particularly for those with higher BMI categories (≥35 kg/m²). Greater COVID-19 death loads have been recorded in regions with higher prevalences of obesity and diabetes, highlighting the importance of these illnesses in global health responses to the pandemic [70]. Obesity is a lifestyle disease that often does not occur by itself. It is usually accompanied by arterial hypertension, diabetes, dyslipidemias, which in themselves are risk factors for a more severe course of COVID-19, and in combination with excess body fat, they pose an even greater risk. Mortality from SARS-CoV-2 infection can be significantly increased by not controlling blood glucose levels. Obese patients may have an impaired immune response, and due to their high body weight, they make it difficult to provide assistance, which may increase the risk of a severe course of coronavirus disease. Adipose tissue, which is in excess in obese people, plays an important role in the chronic inflammatory process. It contains many inflammatory cells that are responsible for increasing the concentration of C-reactive protein (CRP) and pro-inflammatory cytokines [71]. Addressing these determinants through improved metabolic management and preventative health interventions is crucial in lowering the public health burden of COVID-19, particularly for at-risk populations worldwide. According to these findings, pandemic preparedness planning for upcoming medical emergencies should include chronic illness management [72,73]. One of the most commonly used drugs was ceftriaxone, which was administered to as many as 84% of patients. Despite its widespread use, as Erdem *et al*. [75] indicate, ceftriaxone is not effective in the treatment of COVID-19. A published clinical case [75,76] also confirms its lack of therapeutic effect. Similar conclusions apply to cefuroxime – although in silico studies have suggested its potential antiviral activity against key SARS-CoV-2 proteins [76], clinical data are insufficient, and the lack of clinical improvement in patients has also been confirmed in publications [77]. In the center of Bytom, cefuroxime was used much less frequently than ceftriaxone, which may reflect some awareness of the limited effectiveness of this drug. According to the literature, clarithromycin may offer benefits in the treatment of COVID-19 – particularly in reducing fever and achieving faster PCR test results [78–80]. The ACHIEVE study showed that its use was associated with a milder course of the disease [81]. In the studies by Yamamoto et al. and Tsiakos et al. [80,81], clarithromycin was used in only a few patients, suggesting an underestimation of its potential clinical benefits. Another drug used marginally in the analyzed center was ciprofloxacin, which is consistent with the current state of knowledge. In vitro and molecular modeling studies have demonstrated low affinity of this antibiotic for the SARS-CoV-2 protease and its limited therapeutic potential [81–83]. The lack of recommendations for ciprofloxacin use in patients with COVID-19 without confirmed bacterial superinfection has also been highlighted in guideline reviews [84]. In contrast, the use of dexamethasone

(Dexaven) was widespread, especially among women. This is consistent with the results of the RECOVERY study, which demonstrated that the use of 6 mg of dexamethasone daily reduced 28-day mortality in patients requiring oxygen therapy or mechanical ventilation [85]. Additionally, a meta-analysis of RCTs indicates that corticosteroids, including dexamethasone, reduce the risk of death by approximately 20% in patients with severe COVID-19 [86]. All patients from Bytom received anticoagulation, primarily LMWH, in both prophylactic and therapeutic doses. This approach is supported by the literature – RCTs and meta-analyses demonstrate that therapeutic doses of LMWH can reduce mortality in non-critical, hospitalized patients with COVID-19 [87,88]. Furthermore, LMWH may have non-anticoagulant effects, such as improving markers of cellular apoptosis or reducing viral load [89]. In intubated patients, studies have not demonstrated a survival advantage of therapeutic doses of LMWH over prophylactic doses, although the use of LMWH (instead of UFH) was associated with better clinical outcomes [90,91]. However, the combination of high-dose LMWH with aspirin did not reduce mortality or the length of ICU stay, but also did not significantly increase the risk of bleeding [92]. Tocilizumab (RoActemra), an immunosuppressive drug that blocks the IL-6 receptor, was used only in patients with a severe course of disease and elevated IL-6 levels, according to the criteria (IL-6 >100 pg/ml). The use of tocilizumab is consistent with the results of the RECOVERY and REMAP-CAP trials, which demonstrated a reduction in mortality (e.g., from 35% to 31%, HR 0.85; p=0.0028) [93,94]. This effect was particularly evident when tocilizumab was used in combination with corticosteroids, which had a synergistic effect [95,96]. A review of 8 RCTs involving over 6,000 patients confirmed that tocilizumab reduces mortality only when combined with corticosteroids, with RRs of 0.74 and 0.89, respectively [97]. A meta-analysis of ten RCTs (n=6,493) suggested that tocilizumab may provide a benefit in terms of short-term mortality (24.4% vs. 29.0%), although not all results reached statistical significance (OR 0.87; CI 0.74–1.01; p=0.07) [98]. At the same time, this drug reduces the risk of disease progression, ICU admission, and shortens the duration of hospitalization, and its safety profile is considered good [99,100]. Our data generally correspond to the current state of knowledge. The excessive use of certain antibiotics, such as ceftriaxone and cefuroxime, despite the lack of clinical evidence of efficacy, contrasts with the justified use of dexamethasone, LMWH, and tocilizumab in appropriately selected cases. Such observations support the need for ongoing updates to clinical practices based on scientific evidence and recommendations derived from randomized controlled trials. In the study, the mean CRP level was 90.44 mg/L in women and 115.98 mg/L in men, indicating that in both sexes these levels exceeded the prognostically significant thresholds reported in other studies. For example, in a study from Serbia (318 ICU patients), a cutoff value of CRP ≥81 mg/L was used as a predictor of mortality, with a sensitivity of 60–70% and a specificity of 57–63% [101]. Similarly, in a retrospective model of hospitalization, a CRP level >100 mg/L correlated with a significantly higher risk of death [102], which was consistent with observations among men in the Bytom center, where these values often exceeded 100 mg/L. Moreover, a meta-analysis [103] confirms that high CRP levels are associated with poorer prognosis, which is also reflected in data from Bytom, where many patients who died had very high CRP values (e.g., >150 mg/L). Regarding D-dimer, the values in patients from Bytom also exceeded the cutoff values adopted in other studies. In the Serbian study, D-dimer ≥760 ng/mL (i.e., 0.76 mg/L FEU) was found to be a significant predictor of mortality [101]. Meanwhile, in many patients in the Bytom study, D-dimer significantly exceeded this value, from several to a dozen or so mg/L, and in individual cases even exceeded 30 mg/L. In a retrospective model [102], D-dimer >500 ng/mL was also

correlated with an increased risk of death – this threshold was exceeded in almost all patients hospitalized in Bytom. Regarding IL-6, an Egyptian study (180 patients with severe COVID-19) found it to be the most sensitive and specific marker of severe disease, with 100% sensitivity and approximately 93% specificity [104]. In a Serbian study, the threshold value of IL-6 was ≥74.98 pg/mL as a predictor of mortality [101]. In the analysis of patients from Bytom, IL-6 was measured only in selected patients (especially those with a severe course), and these values often significantly exceeded the threshold of 75 pg/mL – in some patients they reached as much as 1319 pg/mL, which clearly indicates extremely severe inflammation and a high risk of death. These data are consistent with the literature, which considers IL-6 the most sensitive indicator of poor prognosis in COVID-19 [103,104]. In summary, biomarkers such as CRP, IL-6, and D-dimer in patients showed high values, consistent with those identified in other studies as predictors of severe disease or mortality. Their use in assessing clinical risk in patients with COVID-19 is strongly supported by data from Bytom, as well as international clinical trials and meta-analyses.

4. Conclusions

IL-6, CRP, and D-dimer are widely recognized biomarkers for predicting severe disease progression and death associated with COVID-19. The following thresholds have been established: IL-6 ~75 pg/mL, CRP ~80–100 mg/L, D-dimer ~500–760 ng/mL – exceeding these thresholds significantly increases the risk of a poor outcome. Meta-analyses confirm that these indicators increase with disease severity, making them useful for risk stratification. To control COVID-19, an accurate line of diagnosis is required to confirm its presence. Interestingly, numerous approaches are available for the diagnosis of COVID-19. The range of treatment methods is also extensive. The task of the medical staff is to choose the appropriate diagnostic and therapeutic methods, as shown by the analysis of patients treated in the COVID-19 ward.

Author Contributions

Conceptualization, D.A., G.C., A.K.K.; methodology, P.O., M.C.C., H.D., G.C., A.K.K.; validation, P.O., M.C.C., H.D., G.C., A.K.K.; formal analysis, D.A., P.O., M.C.C., H.D., D.B.A., K.D., W.M., G.C., A.K.K.; resources, D.A., P.O., M.C.C., H.D., D.B.A., K.D., W.M., G.C., A.K.K.; data curation, D.A., P.O., M.C.C., H.D., D.B.A., K.D., W.M., G.C., A.K.K.; writing—original draft preparation, D.A., P.O., M.C.C., H.D., D.B.A., K.D., W.M., G.C., A.K.K.; writing—review and editing, D.A., P.O., M.C.C., H.D., D.B.A., K.D., W.M., G.C., A.K.K.; visualization, D.A., D.B.A., K.D., W.M., G.C., A.K.K.; supervision, D.A., G.C., A.K.K.; project administration, D.A., G.C., A.K.K. All authors have read and agreed to the published version of the manuscript.

Institutional Review Board Statement

According to the opinion of the Bioethics Committee of the Medical University of Silesia in Katowice this study, as a retrospective one, did not require approval from the bioethics committee.

Informed Consent Statement

Patients' written informed consent was waived due to the retrospective nature of this study.

Data Availability Statement

The data presented in this study are available on request from the corresponding author.

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Conflicts of Interest

The authors declare no conflict of interest.

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