

Received: 2021.12.13  
Accepted: 2022.02.02  
Available online: 2022.02.25  
Published: 2022.03.30

# COVID-19 Pandemic Was Associated with Lower Activity but Not Higher Perioperative Mortality in a Large Eastern European Center

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Data Collection B  
Statistical Analysis C  
Data Interpretation D  
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**Financial support:**

**Conflict of interest:**

**Background:** Surges of critically ill patients can overwhelm hospitals during pandemic waves and disrupt essential surgical activity. This study aimed to determine whether hospital mortality increased during the COVID-19 pandemic and during pandemic waves.


**Material/Methods:** This was a retrospective analysis of a prospective, observational, epidemiological database. All patients who underwent surgery from January 1 to December 31, 2020, were included in the analysis. The setting was a large Eastern European Surgical Center referral center of liver transplant and liver surgery, a major center of abdominal surgery.

**Results:** A total of 1078 patients were analyzed, and this number corresponded to a reduction of surgical activity by 30% during the year 2020 compared with 2019. Despite an increase in surgery complexity during the pandemic, perioperative mortality was not different, and this was maintained during the pandemic wave. The pandemic (OR 1.45 [0.65-3.22],  $P=0.365$ ) and the wave period (OR 0.897 [0.4-2],  $P=0.79$ ) were not associated with hospital mortality in univariate analysis. In the multivariate model analysis, only the American Society of Anesthesiology (ASA) score (OR 5.815 [2.9-11.67],  $P<0.0001$ ), emergency surgery (OR 5.066 [2.24-11.48],  $P<0.0001$ ), and need for surgical reintervention (OR 5.195 [1.78-15.16],  $P=0.003$ ) were associated with hospital mortality.

**Conclusions:** Despite considerable challenges, in this large retrospective cohort, perioperative mortality was similar to that of pre-pandemic practice. Efforts should be made to optimize personnel issues, while maintaining COVID-19-free surgical pathways, to adequately address patients' surgical needs during the following waves of the pandemic.

**Keywords:** **Hospital Mortality • Pandemics • Perioperative Care • SARS-CoV-2**

Full-text PDF: <https://www.medscimonit.com/abstract/index/idArt/935809>

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## Background

Usual surgical activity was disrupted in the context of the new coronavirus (COVID-19) pandemic [1], particularly during the sudden surges in hospitalized patients associated with pandemic waves. These surges were expected to have a significant impact on adult elective surgeries in many countries, thus increasing perioperative mortality and the complication rate [2]. Each national health authority organized and made decisions according to local specificities, considering the COVID-19 pandemic evolution, healthcare characteristics, and other challenges [3-5]. Different recommendations concerning the postponing and cancelling of elective surgeries were proposed.

At a national level in Romania, owing to anticipated limitations in surge-response capacity, decisions were initially made to limit the number of non-urgent surgical interventions to free Intensive Care Unit (ICU) beds for patients with COVID-19 in need of ventilatory support or other specific therapies [6]. Later, hospitals were required to keep a dedicated ward and ICU beds for patients with COVID-19 as a back-up, while entire hospitals (mainly, but not limited to, those specializing in infectious diseases and pulmonology) were converted to COVID-19 facilities.

The impact of the pandemic on patient chronic pathologies and delayed surgeries has still not been very well evaluated, especially in the context of heterogenous measures and diversity of local conditions.

From the anesthesiologists' perspective, the Romanian healthcare system has a history of chronic personnel deficits [7]; it was confronted with several challenges during the first year of the COVID-19 pandemic. The anesthesiologists are also intensive care medicine physicians and are responsible for ICU management and care, like those in various countries worldwide. Thus, the surges of critically ill patients in the successive waves of the pandemic posed challenges for staffing the operating rooms, particularly for non-urgent surgery, which were not fully addressed by emerging guidelines based on accumulating experience in other countries [8]. Medical staff volunteered or were temporarily transferred to other highly understaffed provincial hospitals due to new legislation allowing for relocation of physicians and nurses in areas under severe pressure caused by case overload [9]. Local personnel SARS-CoV-2 outbreaks required home-isolation or even hospitalization of staff members, creating further management difficulties [10]. Also, infrastructure particularities in the local ICUs caused another struggle, namely making patient isolation due to non-SARS-CoV-2 infections very difficult in a local environment with a high prevalence of antimicrobial resistance [11]. Dedicated personnel were hard to summon, which could have sometimes led to suboptimal bed use. This had an impact on surgical activity and, despite workload increase, owing to

medical and administrative reasons, the chronic lack of medical staff was accentuated.

The main objective of this study was to evaluate the impact of the pandemic on perioperative mortality. The secondary objectives were (i) to evaluate the impact of wave periods on perioperative mortality; and (ii) to describe the patient profiles during the first pandemic year.

We hypothesized that diminished availability of medical personnel, restrictive surgical planning, and a lower number of available surgical ICU beds would be reflected in a higher incidence of perioperative mortality and surgical complications during the pandemic.

## Material and Methods

### Design

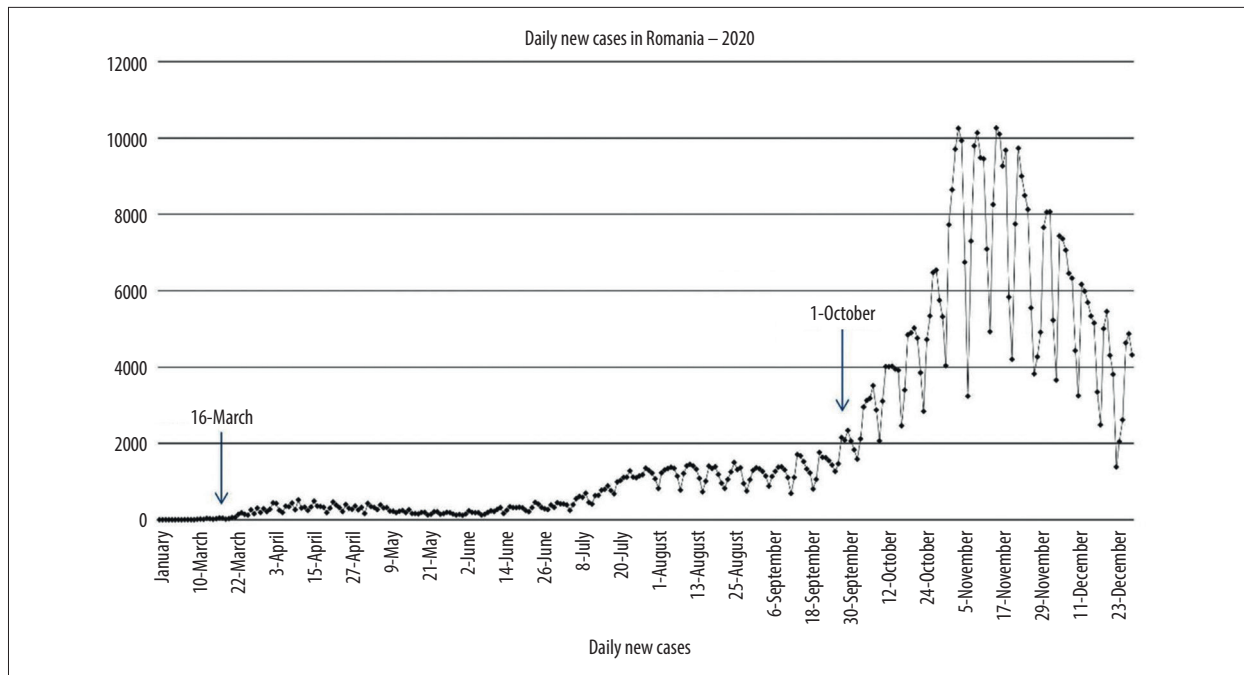
The study was a retrospective analysis of a prospective, observational, epidemiological database and was conducted in a single tertiary, university-affiliated national center, the main national center of liver transplant and liver surgery and a major center for abdominal surgery.

### COVID-19 Pandemic in Romania

The timeline of the COVID-19 pandemic in Romania is illustrated in **Figure 1**. The pandemic was declared by the governmental authorities on March 16, 2020, when a state of emergency was issued with consequent restrictions, which had an impact on hospital activity [12]. This date was used to divide patients in our study into 2 groups by period: pandemic and non-pandemic. Furthermore, a surge in new cases with concomitant impact on ICU bed availability was registered from October 2020 until the end of 2020 (**Figure 1**). The patients undergoing surgery between October 1 and December 31, 2020, were treated in the context of the SARS-CoV-2 wave in data analysis. A comprehensive history of the epidemiology and legal framework of the pandemic in Romania is provided in **Supplementary Table 1**.

### Patients and Data Collection

All patients who underwent surgery from January 1, 2020, to December 31, 2020, in our department were included. The preoperative demographical characteristics (age, sex, American Society of Anesthesiology [ASA] score) and the intraoperative data (type and length of surgery, emergency status, cancer surgery, intraoperative packed red blood cell [PRBC] transfusion) for each patient were entered in an electronic database by the anesthetist at the end of surgery. Hospital mortality was recorded using electronic records.



**Figure 1.** The timeline of the COVID-19 pandemic in Romania. Source: <https://datelazi.ro/> – official platform on COVID-19 from the Romanian Government.

### Statistical Analysis

Data were collected in a Microsoft Excel database and analyzed using SPSS (IBM SPSS Statistics for Windows, version 21.0; IBM Corp, Armonk, NY, USA). A 2-sided  $P < 0.05$  was considered, a priori, statistically significant. Descriptive statistics were expressed as mean  $\pm$  standard deviation or as median with interquartile range (IQR; 25-75%), as appropriate. Normal distribution for continuous variables was evaluated by histograms and by the Kolmogorov-Smirnoff test. The  $t$  test or Mann-Whitney test were used, as appropriate, for comparisons of continuous variables. The chi-squared test was used to compare categorical variables.

We firstly determined the variables associated with 1-year mortality through univariate logistic regression analysis. Secondly, the statistically significant variables in univariate analysis were introduced in a multivariate logistic regression model to identify independent predictors of 1-year mortality. The rule of thumb of 5 to 10 events per variable in the multivariate logistic model was applied.

### Management of Missing Data

There were no missing data in our final database. Therefore, no missing data strategy was required before the statistical analysis.

### Clinical Pathway of Patients

As previously proposed by experts [13], all patients were screened for SARS-CoV-2 prior to elective surgery and if they were positive, their surgeries were either postponed, if possible, or transferred to another center dedicated to managing COVID-19 in surgical patients. There was, however, a small number of patients (5 of 1078) that underwent surgery as emergencies having COVID-19; therefore, no general considerations can be made regarding increased mortality in COVID-19 patients as mentioned by other authors [14].

### Results

There were 1078 surgical patients in our department in 2020. The monthly distribution of surgeries is shown in **Figure 2**. When compared to the previous year (2019), the number of surgical patients corresponded to a reduction of 30% in surgical activity. The cohort demographic and surgical characteristics are shown in **Table 1**. The mean patient age was  $59 \pm 14$  years and 542 (50.28%) patients were female; 655 (60.76%) patients underwent a major surgical procedure; 663 (61.45%) interventions were performed in an oncological context; 216 (20.04%) were emergency surgeries; and 693 (64.3%) had an ASA score  $\geq$  III. The overall perioperative mortality was 3.25% (35 patients). The monthly variation of recorded mortality is shown in **Supplementary Figure 1**.

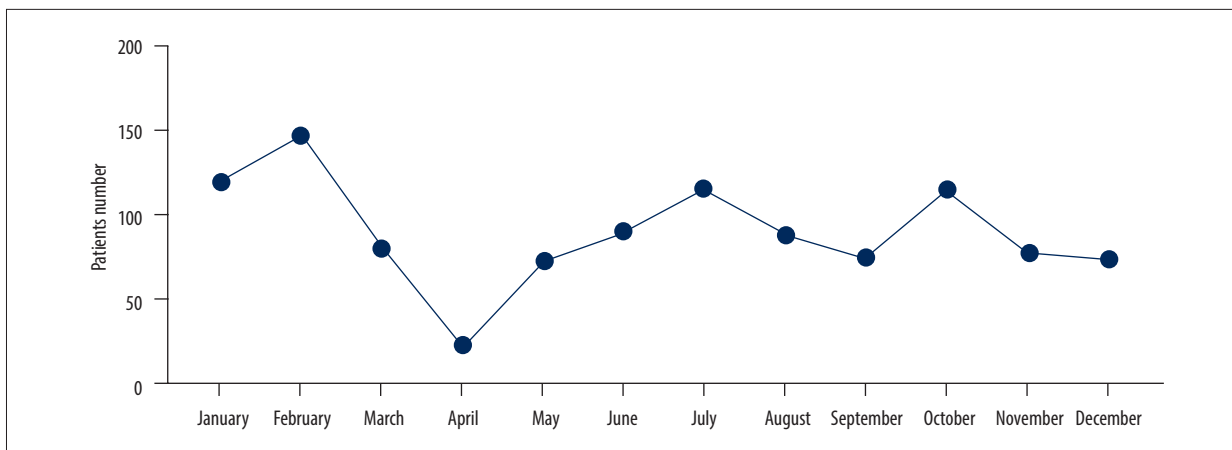


Figure 2. The evolution of the number of surgical patients by month.

Table 1. Patient characteristics during 3 phases: pre-pandemic, pandemic, and during the wave.

Variables	Total (n=1078)	Before pandemic (n=321)	Pandemic (n=757)	P*	Outside of wave (n=490)	SARS-Cov-2 wave (n=267)	P**
Age (years), median [25-75% IQR]	62 [50-69]	61 [50-69]	62 [50-70]	0.552	62 [50-69]	62 [50.5-70]	0.979
Male sex, n (%)	536 (49.72%)	170 (52.96%)	366 (48.35%)	0.166	241 (49.18%)	125 (46.82%)	0.533
Female sex, n (%)	542 (50.28%)	151 (47.04%)	391 (51.65%)		249 (50.82%)	142 (53.18%)	
General anesthesia, n (%)	1064 (98.70%)	317 (98.75%)	747 (98.68%)	0.921	485 (98.98%)	262 (98.13%)	0.326
Major surgery (duration over 90 min), n (%)	655 (60.76%)	174 (54.20%)	481 (63.54%)	0.004	318 (64.90%)	163 (61.05%)	0.293
Duration (min), median [25-75% IQR]	140 [90-210]	130 [80-195]	150 [90-217]	0.005	140 [90-210]	150 [90-230]	0.390
Patients with neoplasia, n (%)	663 (61.45%)	189 (58.88%)	474 (62.62%)	0.249	317 (64.69%)	157 (58.80%)	0.109
Emergency surgery, n (%)	216 (20.04%)	59 (18.38%)	157 (20.74%)	0.376	105 (21.43%)	52 (19.48%)	0.527
Intraoperative PRBC transfusion, n (%)	50 (4.64%)	19 (5.92%)	31 (4.10%)	0.193	20 (4.09%)	11 (4.12%)	0.870
Reintervention required, n (%)	34 (3.15%)	11 (3.43%)	23 (3.04%)	0.739	14 (2.86%)	9 (3.37%)	0.694
ASA score, n (%)				0.146			<.0001
ASA I	43 (3.99%)	9 (2.80%)	34 (4.49%)		17 (3.47%)	17 (6.37%)	
ASA II	342 (31.73%)	95 (29.60%)	247 (32.63%)		140 (28.57%)	107 (40.07%)	
ASA III	603 (55.94%)	195 (60.75%)	408 (53.90%)		274 (55.92%)	134 (50.19%)	
ASA IV	90 (8.35%)	22 (6.85%)	68 (8.98%)		59 (12.04%)	9 (3.37%)	
Mortality	35 (3.25%)	8 (2.49%)	27 (3.57%)	0.363	19 (3.88%)	8 (3.00%)	0.532

\* Comparison between pandemic and extra pandemic period. \*\* Comparison between wave period and the rest of the pandemic period. IQR – interquartile range; ASA – American Society of Anesthesiology risk score; PRBC – packed red blood cells.

**Table 2.** Univariate and multivariate regression analysis of factors associated with mortality.

Variable	Univariate analysis			Multivariate analysis		
	OR	95% CI	P	OR	95% CI	P
Age (year)	1.05	1.019-1.081	0.001			
Sex (Male)	0.734	0.372-1.45	0.374			
Malignancy (yes)	0.942	0.469-1.892	0.867			
<b>ASA score</b>	<b>9.222</b>	<b>4.913-17.312</b>	<b>&lt;0.0001</b>	<b>5.815</b>	<b>2.899-11.662</b>	<b>&lt;0.0001</b>
<b>Emergency</b>	<b>11.152</b>	<b>5.268-23.607</b>	<b>&lt;0.0001</b>	<b>5.066</b>	<b>2.235-11.481</b>	<b>&lt;0.0001</b>
<b>Major surgery</b>	<b>3.22</b>	<b>1.325-7.822</b>	<b>0.01</b>	2.231	0.867-5.737	0.096
<b>Reintervention</b>	<b>9.407</b>	<b>3.779-23.422</b>	<b>&lt;0.0001</b>	<b>5.195</b>	<b>1.780-15.158</b>	<b>0.003</b>
Length of surgery (h)	1.044	0.856-1.273	0.672			
Intraoperative PRBC transfusion	1.256	0.293-5.39	0.759			
Pandemic period	1.447	0.65-3.221	0.365			
Wave period	0.897	0.402-1.999	0.79			

OR – odd ratio; CI – confidence interval; PRBC – packed red blood cells; ASA – American Society of Anesthesiology risk score.

Patients' characteristics are shown by the extra-pandemic, pandemic, and wave periods in **Table 1**. A total of 757 (70.2%) patients had surgery during the pandemic, and 267 (24.76%) patients underwent surgery during the COVID-19 wave. The comparative hospital mortality during the pandemic vs the extra-pandemic period was 3.57% vs 2.49% ( $P=0.363$ ), respectively. Perioperative mortality did not increase during the wave (3.88% vs 3%,  $P=0.532$ ). The patient profiles seemed to be slightly different during the pandemic, with a higher proportion of major (defined as surgery exceeding 90 min) and longer surgery: 174 (54.20%) vs 481 (63.54%) patients and 130 (80-195 min) vs 150 (90-217) min, respectively. Patients pre-pandemic and during the pandemic were similar with respect to age (monthly variation is shown in **Supplementary Figure 2**), ASA category, proportion of emergency surgery (proportion of the emergency interventions recorded monthly are shown in **Supplementary Figure 3**), and need for reintervention (**Supplementary Figure 4**), but there were differences in ASA category between wave-period and outside-of-wave patients: there were proportionally more patients with ASA I and II during the wave: 17 (6.37%) vs 17 (3.47%), and 107 (40.07%) vs 140 (28.57%), respectively, and fewer ASA III and IV patients: 134 (50.19%) vs 274 (55.92%), and 59 (12.04%) vs 9 (3.37%), respectively ( $P<0.0001$ ).

The univariate and multivariate logistic regression analyses results are shown in **Table 2**. In univariate analysis, major surgery, emergency intervention, reintervention, and ASA score were associated with hospital mortality. The pandemic (OR 1.45 [0.65-3.22],  $P=0.365$ ) and the wave period (OR 0.897 [0.4-2],  $P=0.79$ ) were not associated with hospital mortality in univariate analysis. In the multivariate model analysis, only

ASA score (OR 5.815 [2.9-11.67],  $P<0.0001$ ), emergency surgery (OR 5.066 [2.24-11.48],  $P<0.0001$ ), and need for surgical reintervention (OR 5.195 [1.78-15.16],  $P=0.003$ ) were associated with hospital mortality. The statistical significance was unchanged in sensitivity analysis, forcing the pandemic and the wave context in a multivariate model.

## Discussion

In our cohort, we did not find an increased perioperative mortality during the COVID-19 pandemic, despite an increase in surgery complexity, as shown by the higher proportion of major surgery (defined as surgery longer than 90 min), as well as the longer median duration of the interventions. These results are reassuring, considering the huge pressure on ICU beds and medical personnel during the pandemic.

As expected, the elective surgery activity diminished [2]. However, the study design could not directly evaluate the mortality of delayed, rescheduled, or cancelled surgical interventions, nor medium or long-term postoperative mortality.

The decline in our surgical activity was more important following the issue of the emergency state (**Figure 2**). This allowed for reorganization of the activity and better distribution of local healthcare resources and adoption of pandemic precautions as generally stated.

There are some explanations for our findings that disprove the research hypothesis. Firstly, the reduction in surgical activity allowed for a better logistical and resource allocation. This

was possible because our tertiary center is not involved in the main local and regional emergency pathway but provides highly specialized expertise when requested [15]. Secondly, the local medical personnel are already accustomed to difficult and continuously changing logistic conditions [7].

More major surgeries were performed during the pandemic months, which is explainable as these cases were prioritized by the restrictive surgical planning, and their proportion increased. Minor surgeries were more likely to be postponed. Also, it is possible that other centers reoriented these patients due to the already mentioned logistical issues, which led to some general hospitals becoming dedicated COVID-19 centers and closing elective surgical activity altogether [6].

The preponderance of patients with a better general condition during the wave compared with those outside the wave, as indicated by the ASA category differences, suggested there could have been a selection bias during the wave toward healthier patients with fewer comorbidities, which could maximally benefit from surgery. This was not found, however, when comparing pre-pandemic to pandemic patient characteristics.

The main outcomes did not seem to change with the wave period. This finding might be explained by the fact that it was anticipated, and the operating schedule was even more reduced. The ICU had not been overwhelmed at any time.

Perioperative bleeding was statistically different between the pre-pandemic and pandemic cohorts: 5 (1.56%) vs 9 (1.19%) patients ( $P < 0.001$ ), but the clinical significance was minimal, given the low incidence. Also, there was no observable impact of the wave period on bleeding. Intraoperative PRBC transfusion remained low and did not differ either between pre-pandemic and pandemic levels or in regards to the wave period, suggesting a good adherence to previously issued patient blood management recommendations, for which our institution was a pilot center [16].

The perioperative mortality in our cohort was higher than that reported in other multicenter international cohorts (3.5% vs 1.5%) [17]. However, our cohort was similar to the usual activity, showing more severe patients (higher ASA score III vs I-II) and an older population, which was not different from that of pre-pandemic months. A second explanation is that we did consider emergency surgeries, not only elective patients, as reported in this international cohort.

There has been evidence during the pandemic that providing COVID-19-free surgical pathways is beneficial for patients in terms of mortality, respiratory complications, and SARS-CoV-2 infections [18]. Given the very low number of operated COVID-19 patients, the strict adherence to preoperative

screening, as well as the protocol for transfer to dedicated COVID-19 centers, we believe our results confirm this hypothesis.

However, there were considerably fewer patients who underwent surgery during the pandemic year, which also includes 2.5 months previous to the decree of the emergency state, as compared with the previous year. The effect of postponing or cancelling these surgeries has not been addressed by our study and remains a potential cause of excess mortality at a regional and national level [19].

The strength of this study is that it shows data of epidemiological and public health interest from a large Eastern European surgical center during the COVID-19 pandemic with a clear and simple methodological design. To the best of our knowledge, this is the largest Eastern European study addressing this issue.

### Study Limitations

The first limitation of this study is its single-center and observational design. However, we already pointed out above that our center has a specific role in the local national healthcare system, with very specialized surgical activity.

Another limitation is the small number of variables considered in the data analysis. Other confounding factors could have had an impact on surgical mortality. Unfortunately, the database was not initially created with the purpose of exhaustively analyzing perioperative mortality. However, this limitation might generate an indiscriminative bias, affecting both pandemic and non-pandemic patients in data analysis, thus keeping the findings relevant in the current context. Also, the database was robust, without any missing data.

Ideally, the patients needed to be compared with those of the previous years, considering the same months of the year. This is another limitation of this study. However, we assumed that surgical activity is not mainly season- or month-dependent.

### Conclusions

Despite considerable challenges regarding logistics and personnel, perioperative mortality was similar to pre-pandemic practices in our cohort, that of a tertiary care, academic hospital, the main center of liver transplant and a major center for abdominal surgery in an Eastern European country. This seems reassuring at a local level and should be regarded as a potential model for clinical practice. Special consideration should be given to pandemic waves, when surges of patients can lead to selection of less ill patients, with difficult to estimate consequences on mortality on a national level.

Efforts should be made to optimize personnel issues, while maintaining COVID-19-free surgical pathways to adequately address surgical needs during following waves of the pandemic.

### Department and Institution Where Work Was Done

This study was conducted in Fundeni Clinical Institute, Bucharest, Romania.

### Ethics Approval and Consent to Participate

The study was approved by the local ethics committee. Due to the observational nature of the study, informed consent was waived. The study complied with the tenets of the Declaration of Helsinki, Ethical Principles for Medical Research Involving Human Subjects.

## Supplementary Materials

**Supplementary Table 1.** History of the epidemiology and legal framework of the pandemic in Romania.

National level	Institutional level
<b>16.03.2020</b> Romania declares state of emergency	
<b>18.03.2020</b> Emergency medicine, infectious disease and anesthesia and intensive care resident doctors are set to interrupt their current rotations, excepting the rotations in the aforementioned specialties and report to their guidance offices in order to plan their duty hours/shifts within the departments/units of their chosen specialty.	<b>18.03.2020</b> Emergency medicine, infectious disease and anesthesia and intensive care resident doctors are set to interrupt their current rotations, excepting the rotations in the aforementioned specialties and report to their guidance offices in order to plan their duty hours/shifts within the departments/units of their chosen specialty.
	<b>19.03.2020</b> Within FCI, a White Plan is in place, outlining the strategies in case of emergency situations. As stated in the White Plan, in the event of Code Red Emergency, not only the FCI Commandment of Crisis, but also the Crisis Unit of each department are set to be activated. In case of Code Red situations, all departments are required to elaborate a reaction plan that must include: – A workforce mobilization plan (mobilizing additional personnel) – Assigning responsibilities: assessment of staffing requirements and available resources, estimating the number of patients that can be relocated, transferred, or discharged from hospital.
	<b>23.03.2020</b> All nurses are prohibited from practicing outside working hours in private hospitals or in any medical facilities other than the one they are employed in.
	<b>23.03.2020</b> All departments are required to assign a dedicated hospital room, equipped with PPE (personal protective equipment) that shall remain unoccupied. These isolation rooms are designated for admitted patients that present signs and symptoms of COVID-19 during their hospitalization.

### Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

### Declaration of Figures' Authenticity

All figures submitted have been created by the authors who, confirm that the images are original with no duplication and have not been previously published in whole or in part. Except Figure 1: Source: <https://datelazi.ro/> – official platform on COVID-19 from the Romanian Government.

Supplementary Table 1 continued. History of the epidemiology and legal framework of the pandemic in Romania.

National level	Institutional level
	<p><b>24.03.2020</b> Outlining general control measures to break chains of transmission of SARS-CoV-2 within the hospital:</p> <ul style="list-style-type: none"> <li>• All personnel shall comply with the triage procedures by completing the dedicated form and measuring their temperature at the beginning of their working hours.</li> <li>• Suspected cases among the healthcare workers shall be reported by the head nurse to the chief physician.</li> <li>• Interpersonal communication among professionals shall be conducted via telephone, thus limiting unnecessary contact and movement between hospital departments.</li> <li>• Establishing a reasonable shift schedule for nurses and other healthcare workers, who are going to work strictly in only one designated section of the ward throughout the entire pandemic period (no ward changes are allowed)</li> <li>• Only designated medical personnel is allowed to enter patient rooms</li> <li>• Entry and exit should be minimized and limited to: providing treatment, clinical examination, nursing, serving meals, cleaning, and decontamination</li> <li>• To the extent possible, a maximum of 2 patients should be housed in the same room during the pandemic period</li> <li>• All personnel should strictly comply with the protective health measures before entering patient rooms</li> <li>• All health workers must comply with the hand hygiene practices</li> <li>• All personnel is required to wear a simple facemask at all times when in contact with patients who are not suspected/ confirmed COVID-19 cases</li> <li>• PPE (personal protective equipment) and biohazard containers must be always available</li> <li>• A dedicated room must be assigned for isolation and medical treatment of suspected COVID-19 cases.</li> </ul>
<p><b>25.03.2020</b> New rules are proposed for granting leave and health social security benefits during the state of emergency</p>	
<ul style="list-style-type: none"> <li>• <b>25.03.2020</b> NSC announces changes in granting medical services during the state of emergency:</li> <li>• All health services necessary for diagnosis and treatment of COVID-19 are granted to all individuals on Romanian territory during the state of emergency period and are covered by the Health Minister budget or by the Unique National Fund of Health Insurances.</li> <li>• With a view to chronically ill patients with a stable treatment scheme, primary care physicians may continue writing prescriptions, with no need of a specialist to re-evaluate the case or a new medical letter.</li> <li>• Throughout the state of emergency, remote consultations in primary care are provided for acute/ subacute respiratory symptoms or other clinical manifestations that may be suggestive of COVID-19.</li> </ul>	



**Supplementary Table 1.** History of the epidemiology and legal framework of the pandemic in Romania.

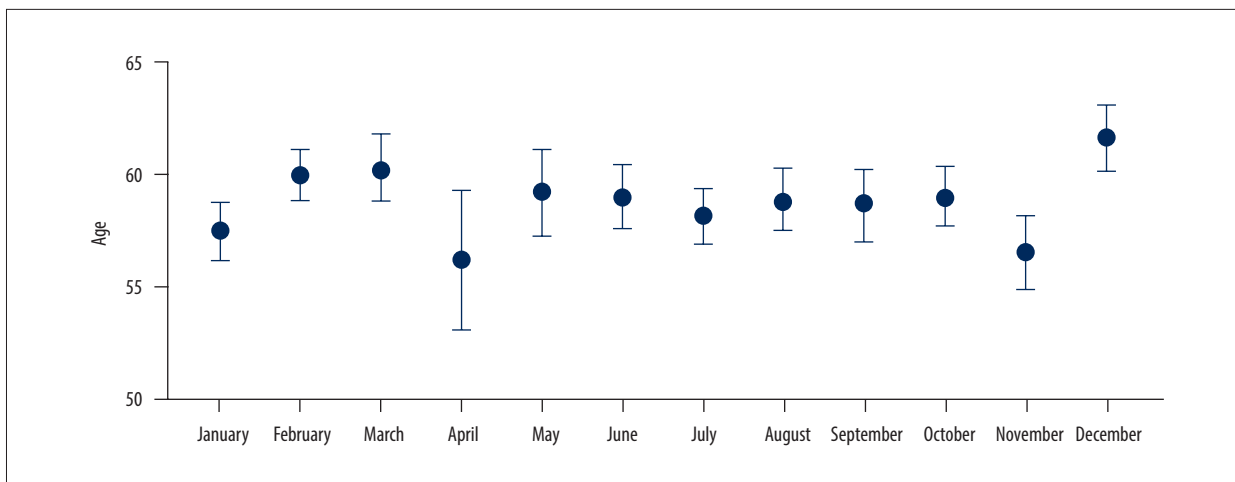
National level	Institutional level
<ul style="list-style-type: none"> <li>Primary care physicians and specialists who have a contractual agreement with the National Health Insurance House may also write medical prescriptions for routine treatment for people with chronic conditions who are unable to attend a hospital or clinic in person. Under these circumstances, the online electronic prescription will be made available to the patient using electronic communication services.</li> <li>The validity of referral letters to clinical or paraclinical specialists, prescriptions for medical devices, approval decisions for PET-CT investigations shall be extended for 90 days.</li> </ul>	
<p><b>25.03.2020</b> NHH: National Health Curative Programs comprises non-urgent diseases that nonetheless require further treatment and investigations (chemotherapy, radiation therapy, CRRT, treatment for chronic hepatitis recurrence after liver transplantation). Regarding these conditions, the attending physician decides upon the possibility of postponing the treatment/investigations for 14 days.</p>	
<p><b>25.03.2020</b> Organ Transplantation is considered an urgent surgical procedure, thus both the donor, as well as the recipient must be tested for COVID-19.</p>	
<p><b>02.04.2020</b> Ministry of Health and National Health Insurances House Order nr 539/437/2020 is issued, stipulating the prolongation of the regulation of the Ministry of Health and National Health Insurances House Order nr. 397/836/2018 regarding the approval of bundled services and the framework agreement that stipulates the conditions of granting medical care, medication and medical devices within the Social Security Health system for 2018-2019, the prorogation of certain terms and the implementation of health policies throughout the state of emergency.</p>	
<p><b>02.04.2020</b> Romanian Society of Anesthesia and Intensive Care Medicine announces an international humanitarian mission based in Italy, with teams comprising emergency medicine and anesthesia and intensive care medical doctors and certified nurse practitioners.</p>	
<p><b>05.04.2020</b> Emergency situations department issues a plan to organize and optimize intensive care units: assigning a coordinator responsible for COVID-19 matters, epidemiological assessment of ICU personnel, optimization of shifts schedule in both COVID and non-COVID areas, sufficient O2 supplies to meet O2 demands, minimizing the risk of contamination among healthcare professionals working in non-COVID areas.</p>	
<p><b>06.04.2020</b> A specific protocol is issued about the management of the deceased with confirmed SARS-CoV-2 infection.</p>	

**Supplementary Table 1.** History of the epidemiology and legal framework of the pandemic in Romania.

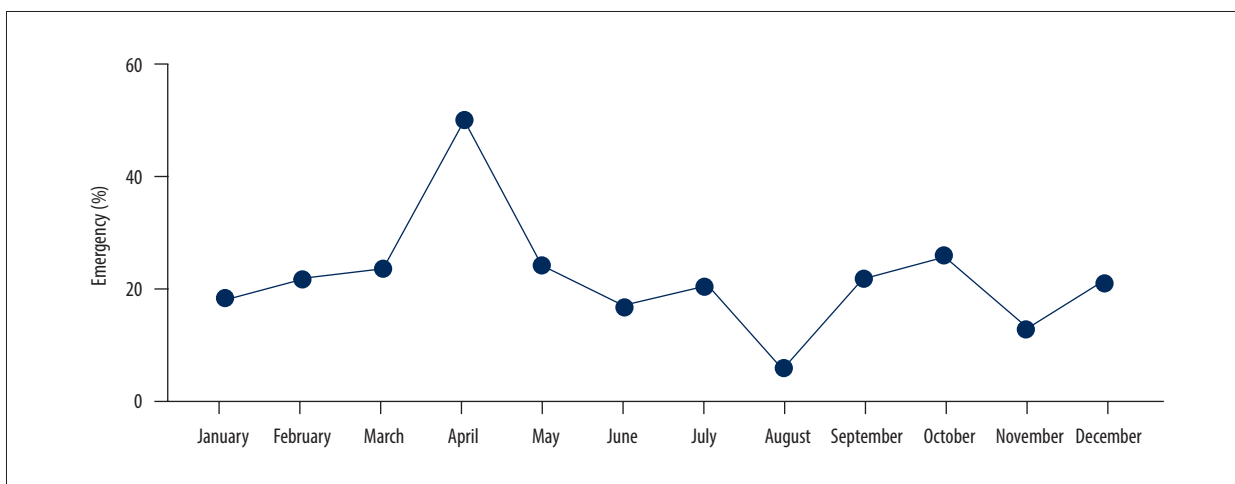
National level	Institutional level
<p><b>07.04.2020</b> Ministry of Health. Public Health District Authority Bucharest: a minimal set of data regarding the suspected COVID case must be immediately reported over the telephone to the public health district authority of Bucharest. Moreover, a surveillance form for COVID-19 confirmed cases must be completed and sent to the public health district authority of Bucharest. All deaths of suspected/probable/confirmed COVID-19 cases must be immediately reported over the telephone and a surveillance form must be transmitted by fax within 24 hours from death.</p>	
<p><b>09.04.2020</b> State Secretary, head of Emergency situations Department issues the following Order: All functional mechanical ventilators produced by Dräger company from all public hospitals in Romania will be at the Emergency Situations Department' disposal. All these mechanical ventilators shall be reconditioned in a centralized manner and then introduced in daily activity.</p>	
	<p><b>13.04.2020</b> Starting with 13.04.2020 all patients admitted to Fundeni Clinical Institute will be tested for SARS-CoV-2</p>
	<p><b>13.04.2020</b> Scheduling for SARS-CoV-2 testing of medical personnel based on level of exposure.</p>
	<p><b>15.04.2020</b> Reorganizing of Fundeni Clinical Institute to provide care for suspected COVID-19 patients. Assigning dedicated areas in both Building A and Building B for suspected COVID-19 patients, defining internal routes and flows for suspected/confirmed patients in both hospital buildings.</p>
	<p><b>16.04.2020</b> Internal routes for suspected COVID-19 patients in Building A of Fundeni Clinical Institute: first floor will be entirely marked as red zone; second floor: A1, A2 and B sections are considered red zone. Upon finalization of fit-out work in Building B, all patients will be admitted in the red zone of Building A.</p>
<p><b>17.04.2020</b> Ministry of Health announces the list of approved medical institutions for providing care during the COVID-19 pandemic along with recommendations of transporting and transferring suspected patients in accordance with patient's pathology and hospital specifications: Grigore Alexandrescu Emergency Clinical Hospital for Children, Medical Centre Policlinico di Monza, Filantropia Clinical Hospital, Nicola Malaxa Clinical Hospital, Carol Davila Military Hospital ROL2.</p>	
<p><b>28.04.2020</b> Assigning a code for COVID 19 disease: diagnosis code that shall be used 64-other unclassified viral diseases.</p>	
<p><b>29.04.2020</b> The validity of the documents issued by public authorities that are set to expire during the state of emergency is extended.</p>	

**Supplementary Table 1.** History of the epidemiology and legal framework of the pandemic in Romania.

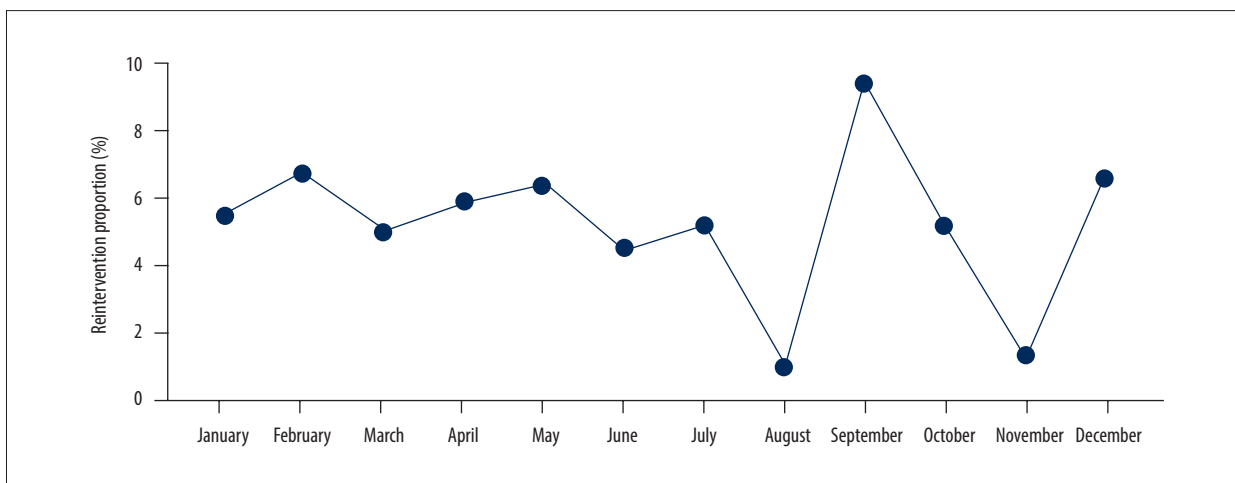
National level	Institutional level
<b>15.05.2020</b> Romania declares State of Alert.	
	<b>18.05.2020</b> Adopting measures to organize the activity in non-COVID medical units during the state of alert period.
	<b>20.05.2020</b> Changes are made to the operating procedure regarding the newly admitted patients: Building A: ICU III (first floor) will become green zone as well as section C of the first floor. ICU red zone: section A2 (second floor), patient room 255. Other internal routes and circuits remain valid until 1 <sup>st</sup> of June 2020.
	<b>20.05.2020</b> ICU III will have two remunerated doctors on duty. Red zone is attended by the second line on duty who may be contacted on the ICU III dedicated telephone.
<b>20.05.2020</b> Public Health District Authority of Bucharest proceeds to the annulment of the order stipulating that “all medical personnel is prohibited from working during the COVID-19 pandemic in any other medical facility than the one they are employed in”.	
	<b>24.06.2020</b> ICU consultations throughout COVID-19 pandemic: limitation of medical consultations for terminally ill patients who are beyond medical rescue; these cases shall be undertaken by the attending doctor/head chief, thus ensuring a better management of the scarce medical and human resources in ICU.
	<b>04.11.2020</b> Epidemiological investigations carried out in clinical wards require in case of COVID outbreaks the following measures to be adopted: Minimizing admissions for a period of at least 5 to 7 days, transferring COVID patients to dedicated hospitals, non COVID emergencies shall be redirected to other wards in FCI or other agreed- upon hospitals, all personnel must be tested.
<b>11.11.2020</b> Identifying all medical personnel available for relocation of COVID taskforce to Victor Gomoiu Clinical Hospital of Children, Grigore Alexandrescu Emergency Clinical Hospital for Children and Filantropia Clinical Hospital.	
<b>26.11.2020</b> Identifying all medical personnel available for relocation to Sf. Ioan Emergency Clinical Hospital is requested.	<b>12.11.2020</b> Revising the working schedule of medical personnel to construct a reasonable shift system, ensuring that shifts are overlapping by at least 1 hour.
	<b>21.12.2020</b> FCI is included on the list of dedicated medical facilities for treating COVID 19 patients by Order 555/2020.
	<b>21.12.2020</b> Authorization of ICU COVID 19 modular healthcare structure-4 beds and 25 beds in A2 section – Neurology ward for confirmed COVID-19 patients.
	<b>24.12.2020</b> Taking into consideration the assigning of FCI as a dedicated COVID medical facility by Order 555/2020, it is brought to attention the establishment of the COVID structure: section A2, second floor-Neurology.



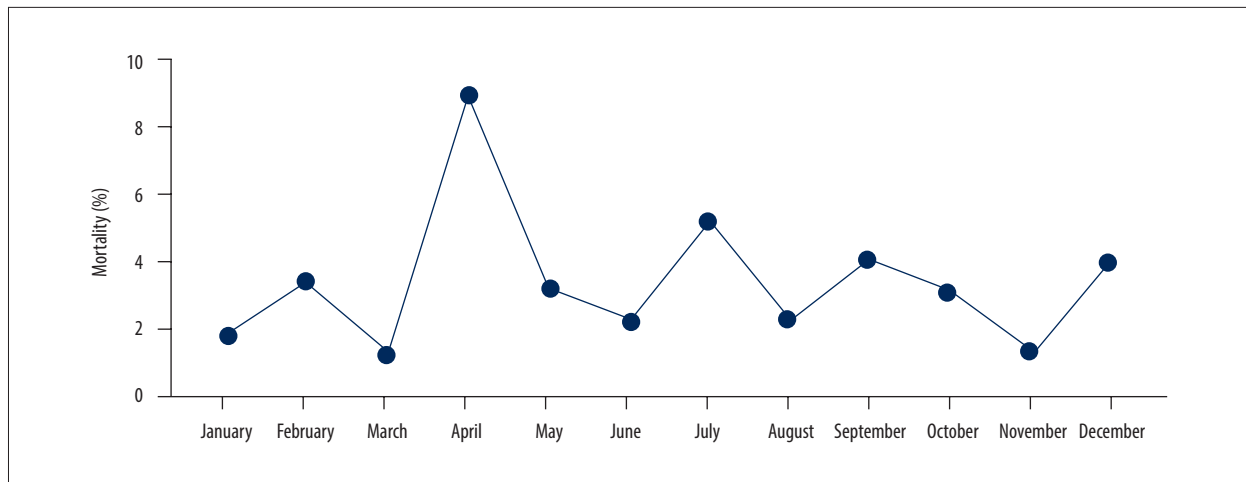
Supplementary Figure 1. General mortality monthly recorded.



Supplementary Figure 2. Distribution of the patients mean age monthly.



Supplementary Figure 3. The proportion of the emergency interventions recorded monthly.



Supplementary Figure 4. Reintervention proportion of the surgical patients labeled monthly.

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