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# The impact of first wave of the SARS-CoV-2 2019 pandemic in Poland on characteristics and outcomes of patients hospitalized due to stable coronary artery disease

Justyna Jankowska-Sanetra et al., Impact of the pandemic on patients with stable CAD

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## Abstract

**Background:** An investigation of baseline characteristics, treatment, and outcomes in patients with stable coronary disease after the first wave of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic may provide valuable data and is beneficial for public health strategy in upcoming years.

**Methods:** A multi-institutional registry, including 10 cardiology departments, was searched for patients admitted from June 2020 to October 2020. The baseline characteristics (age, gender, symptoms, comorbidities), treatment (non-invasive, invasive, surgical), and hospitalization outcome (mortality, myocardial infarction, stroke, composite endpoint — major adverse cardiac and cerebrovascular events [MACCE]) were evaluated. The comparison was made to parameters presented by patients from the same timeframe in 2019 (June–October). Multivariable analysis was performed.

**Results:** Number of hospitalized stable patients following lockdown was lower (2498 vs. 1903;  $p < 0.0001$ ). They were younger (68.0 vs. 69.0;  $p < 0.019$ ), more likely to present with hypertension (88.5% vs. 77.5%;  $p < 0.0001$ ), diabetes (35.7% vs. 31.5%;  $p = 0.003$ ), hyperlipidemia (67.9% vs. 55.4%;  $p < 0.0001$ ), obesity (35.8% vs. 31.3%;  $p = 0.002$ ), and more pronounced symptoms (Canadian Cardiovascular Society [CCS] III and CCS class IV angina: 30.4% vs. 26.5%;  $p = 0.005$ ). They underwent percutaneous treatment more often (35.0% vs. 25.9%;  $p < 0.0001$ ) and were less likely to be referred for surgery (3.7% vs. 4.9%;  $p = 0.0001$ ). There were no significant differences in hospitalization outcome. New York Heart Association (NYHA) class IV for heart failure was a risk factor for both mortality and MACCE in multivariate analysis.

**Conclusions:** The SARS-CoV-2 2019 pandemic affected the characteristics and hospitalization course of stable angina patients hospitalized following the first wave. The hospitalization outcome was similar in the analyzed time intervals. The higher prevalence of comorbidities raises concern regarding upcoming years.

**Key words:** COVID-19, coronavirus, lockdown, coronary artery disease, pandemic

## **Introduction**

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic spread across the globe and affected life in many aspects. By October 2021 over 239 million people had suffered from infection, including only confirmed cases [1]. As such, the healthcare system in many counties remains in jeopardy. The effect of increased mortality, not only from the infection itself but also from other diseases, became apparent. According to the Polish

National Primary Statistical Department, there were over 67,000 more deaths in 2020 than in 2019 in Poland, which highly exceeds the number of deaths from the infection itself [2].

Circulatory diseases, particularly heart conditions, remain the main cause of mortality and morbidity in developed countries. The investigation of the impact of the lockdown on cardiological care is of the highest priority because rapid intervention in this area is required to prevent a great number of deaths and hospitalizations. In Poland, as well as in other countries, several analyses have already been performed. However, they include mainly acute coronary syndrome (ACS) cases – their incidence and course during the pandemic [3–6]. As such, some additional analyses, considering mainly stable coronary disease, should be performed because those patients stand as a major proportion of cases referred to interventional cardiology departments. Furthermore, the investigation may provide valuable data and is beneficial for public health strategy in upcoming years

The aim of the report is to investigate the patient profile, the number of hospitalizations, and the outcomes in patients with stable coronary disease referred to invasive cardiology department for diagnosis and treatment after the first wave of the SARS CoV-2 2019 pandemic.

## **Methods**

### ***Multi-institutional registry***

The report contains data from the invasive cardiology network in Poland, which includes 10 departments. The data regarding patient hospitalization are processed with the medical management software. Because scheduled hospitalizations were limited during the lockdown, the data from June to October 2019 and June to October 2020 were imported to investigate the potential effect of the first wave of the pandemic on patients with stable coronary artery disease (CAD).

### ***Selected parameters***

The following data from the database were included in the analysis: the patient's unique hospitalization number, hospitalization department, data of admission and discharge, discharge characteristics, primary diagnosis (initial and after diagnostic process), other

diseases, performed procedures, anamnesis, treatment, patient condition, hospitalization course, and complications (death, myocardial infarction, stroke, surgical intervention, cardiac surgery procedure). The composite endpoint comprised major adverse cardiac and cerebrovascular events (MACCE) including death, myocardial infarction, and stroke.

### ***Local Research Ethics Board consent***

No Research Ethics Board consent was required for the study. The report is retrospective, the data is a readily available dataset, and no intervention to patients was performed. The National Code on Clinical Trials has reported that ethical approval is not necessary for real retrospective studies (National Code on Clinical Researches, 2011).

### ***Statistical analysis***

The continuous data are presented as mean  $\pm$  standard deviation or median (interquartile range). Categorical data are shown as numbers (percentage). The Shapiro-Wilk test was used to determine normal distribution in continuous data. In cases where normal distribution was confirmed, Student's t-test was used for analysis. In cases where normal distribution was rejected, the Mann-Whitney U test was used for continuous data investigation. The chi-square test was used for categorical data inquiry. Cox proportional hazards regression model was used for multivariable analysis. Goodness of fit of each multivariate analysis model was verified using the chi-square test. The data were analyzed using MedCalc v.18.5 software (MedCalc Software, Ostend, Belgium). The p-value of  $\leq 0.05$  was considered as statistically significant.

### ***Data presentation***

The data were divided into categories and presented as number of admissions, information regarding patient condition on admission, demographical data (age and gender), data regarding comorbidities, symptom characteristics, hospitalization course, and hospitalization outcome, including mortality analysis.

## **Results**

The number of patients hospitalized due to stable CAD was significantly lower in June–October 2020 (following the first lockdown) than in the same period in 2019.

Although the patients presented with the same age and gender, the comorbidity characteristics varied. Significantly higher numbers of patients with arterial hypertension, obesity, diabetes, and hyperlipidemia were noted after the first wave of coronavirus pandemic (Table 1).

Regarding symptom characteristics, a significantly higher number of patients presented with Canadian Cardiovascular Society (CCS) III and CCS class IV of angina after the lockdown than in June–October 2019. However, the number of patients admitted with the most severe angina (CCS IV) was similar (Table 1).

The treatment was very different in June–October 2020 than in June–October 2019. Fewer patients were treated non-invasively, while a greater number of patients qualified for invasive treatment. Notably, a significantly fewer cases were referred for coronary artery bypass grafting procedure (Table 2).

When considering hospitalization outcome, there were no significant differences in mortality, infarction rate, stroke rate, and composite endpoint rate (Table 3).

Cox proportional-hazards regression model revealed no impact of the hospitalization period on mortality (Figs. 1, 2). New York Heart Association (NYHA) class IV for heart failure was the risk factor for mortality (Fig. 1).

Regarding the composite endpoint, NYHA class IV for heart failure was associated with higher risk of MACCE (Figs. 3, 4).

## **Discussion**

The effect of the pandemic on healthcare has been touched on in many reports. It is clear that many patients did not receive proper healthcare throughout the pandemic, mainly because of healthcare system paralysis, but also due to fear of contact with potentially infected patients in both public and private hospitals. In fact, the fear of coronavirus disease 2019 (COVID-19) is a reason for patients not attending medical care when experiencing any

kind of symptoms, representing multiple diseases [7–11]. It must be underlined that pre-existing cardiovascular disease are especially prone to coronavirus infection and may undergo adverse outcomes due to the infection [12–15].

Not surprisingly, people admitted to hospital following the lockdown had more comorbidities, often untreated or treated inadequately. This is a worldwide phenomenon [16–21]. Furthermore, the pandemic and the lockdown heavily affected people's daily routine. It is important to mention that physical activity has an effect in both the prevention and treatment of coronary artery disease [22, 23]. Avoidance of physical exercise, an unhealthy diet, and mental and social problems largely impacted populational health. As a result, a higher number of patients with non-communicable diseases may be expected. Consequently, the long-term outcome in most of those cases is uncertain.

Because patients presented with very different baseline characteristics, the treatment was also different in both time intervals. It seems that despite a decrease in the number of patients hospitalized for stable CAD, the number of percutaneous interventions was even higher in the period following the first wave of the pandemic. This leads to the opposite conclusion to the one reported by other authors [24–26]. However, there are significant differences regarding study methodology. First, our investigation refers to patients admitted following the first wave, which describes the impact of clinical care limitation. In this situation, following lockdown withdrawal, a great number of hospitalizations should be expected due to the greater number of patients with severe symptoms and long lines of patients awaiting diagnostic and therapeutic processes. This effect is probably strongly limited by fear of hospitalization and potential infection, particularly in the elderly. Importantly, the analysed timeframe refers to a time during which vaccination was not available.

The changes of treatment in time intervals need to be discussed in light of recently published results of the 'Ischemia' trial, which did not find evidence that an initial invasive strategy in stable CAD, as compared with an initial conservative strategy, reduced the risk of ischemic cardiovascular events or death from any cause over a median of 3.2 years [27]. However, it must be noted that both the 'Ischemia' trial and the guidelines for myocardial revascularization [28] underline the importance of adequate medical treatment to prevent symptoms and improve survival. Importantly, the trial was conducted during normal healthcare accessibility, prior to the pandemic. During the pandemic, each case needed to be assessed individually, taking into consideration limited accessibility to both basic healthcare

(general practice) and cardiovascular care. Furthermore, the patients admitted following lockdown had more pronounced symptoms than patients admitted in the corresponding timeframe in 2019 (see Table 1). The perspective of future waves of the pandemic and upcoming lockdowns also played a role in the decision-making process.

It should be emphasized that some authors already point out the consequences of postponing elective percutaneous revascularization procedures in stable patients [26].

The decrease in the number of patients referred for surgical treatment may also be associated with limited healthcare accessibility. Firstly, avoidance of multiple hospitalizations was strongly required during the pandemic, which might have affected the heart-team decisions in borderline cases to operate in favor of percutaneous treatment. Secondly, the decisions might have been affected by the perspective of an upcoming second wave of the pandemic, taking into consideration the next lockdown. This could interrupt both diagnostic and therapeutic processes and pose an even greater threat for patients. In this scenario, multiple hospitalizations, including staged intervention, complicated diagnostic processes, coronary artery bypass grafting, and longer rehabilitation following surgery, are not advantageous. Furthermore, the potential of coronavirus infection increases the perioperative risk significantly. Global reports present similar reductions in elective surgical procedures [29].

Regarding the hospitalization outcome, there were no significant changes in the analyzed timeframes. This may seem surprising, but it must be remembered that the report contains stable CAD cases. As such, the true impact of the pandemic, including the adverse outcome of the development and lack of control of non-communicable diseases, may yet become visible in a long-term observation. Furthermore, it may be speculated that the most severe cases with initially stable coronary disease underwent an ACS, which excluded them from this study. There are reports that the incidence of ACS cases is much higher (which includes our institutional experience). Those cases develop mostly on the basis of pre-existing stable CAD, which was treated in earlier stages prior to the pandemic. From this perspective, the similar number of deaths in the analyzed timeframes may be related to shifting the most complicated and most severe cases directly to the ACS cohort in 2020.

Similar conclusions can be drawn from the multivariable analysis. There was no direct impact of the hospitalization period on the risk of mortality or MACCE in the stable patient



cohort. Importantly, NYHA class IV for heart failure was a risk factor for mortality and MACCE.

### ***Limitations of the study***

This report is a retrospective dataset analysis, and most of the limitations are associated with this methodology. What is more, the investigation represents only part of the picture, because due to the delay in diagnosis and treatment, some patients might have suffered from ACS during the first wave of the pandemic or just following the first wave, which excluded them from the report and might have affected the comparison regarding the most severe cases. Furthermore, the true long-term outcome in those patients is yet unknown because they presented with higher incidence of non-communicable diseases, which may have an impact on the incidence of ACS cases in the future as well as on mortality and morbidity.

### **Conclusions**

In conclusion, the SARS-CoV-2 2019 pandemic affected the characteristics and hospitalization course of stable angina patients hospitalized following the first wave. The hospitalization outcome was not significantly affected in this group of cases. However, the high incidence of non-communicable diseases in hospitalized patients is disturbing because an increase in acute cerebrovascular events is to be expected in forthcoming years. Consequently, a great effort should be made to provide cardiovascular care and both primary and secondary prophylaxis to avoid a dramatic rise in the incidence of acute cardiovascular events.

**Conflict of interest:** None declared

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**Table 1.** Baseline patient characteristics.

	<b>2019 (June–October)</b>	<b>2020 (June–October)</b>	<b>P</b>
Hospitalizations due to stable CAD/overall CAD hospitalizations	2498/5299 (47.2%)	1903/4523 (42.1%)	<b>&lt; 0.0001</b>
Age	69.0 (62.0–75.0)	68.0 (62.0–74.0)	<b>0.019</b>
Male gender	1541(61.7%)	1221 (64.2%)	0.093
Arterial hypertension	1885 (75.5%)	1684 (88.5%)	<b>&lt; 0.0001</b>
Hyperlipidemia	1384 (55.4%)	1293 (67.9%)	<b>&lt; 0.0001</b>
Diabetes	786 (31.5%)	679 (35.7%)	<b>0.003</b>
Obesity	783 (31.3%)	682 (35.8%)	<b>0.002</b>
Active smoking	422 (16.9%)	359 (18.9%)	0.089
History of stroke	141 (5.6%)	80 (4.2%)	<b>0.033</b>
Peripheral artery disease	224 (8.9%)	146 (7.7%)	0.125
CCS III + CCS class IV for angina	662 (26.5%)	578 (30.4%)	<b>0.005</b>
CCSIV class for angina	79 (3.2%)	56 (2.9%)	0.675
Symptoms for HF (NYHA II–IV class)	1237 (49.5%)	906 (47.6%)	0.209

Data are presented as number (percentage) and median (interquartile range); CAD — coronary artery disease; CCS — Canadian Cardiovascular Society; HF — heart failure; NYHA — New York Heart Association class for heart failure

**Table 2.** Treatment during hospitalization.

<b>Treatment during hospitalization</b>	<b>2019 (June–October); N = 2498</b>	<b>2020 (June–October); N = 1903</b>	<b>P</b>
Non-invasive treatment	149 (7.8%)	86 (4.5%)	<b>0.0346</b>
Coronarography	1549 (62.0%)	1110 (58.3%)	<b>0.0134</b>
Percutaneous revascularization	647 (25.9%)	667 (35.0%)	<b>&lt; 0.0001</b>
Patients referred for CABG	108 (4.9%)	40 (3.7%)	<b>0.0001</b>

Data are presented as number (percentage); CABG — coronary artery bypass grafting

**Table 3.** Hospitalization outcome.

<b>Hospitalization outcome</b>	<b>2019 (June–October); N = 2498</b>	<b>2020 (June–October); N = 1903</b>	<b>OR</b>	<b>P</b>
Death	5 (0.2%)	1 (0.05%)	0.2	0.19
Myocardial infarction	2 (0.08%)	2 (0.1%)	1.3	0.78
Stroke	2 (0.08%)	3 (0.2%)	1.9	0.45
MACCE	9 (0.4%)	6 (0.3%)	0.9	0.79

Data are presented as numbers (percentage); OR — odds ratio, MACCE — major adverse cardiac and cerebrovascular events (death, myocardial infarction, stroke)



**Figure 1.** Forest plot of risk ratios for mortality (Cox proportional hazards regression model). Markers represent point estimates of risk ratios. Horizontal bars indicate 95% confidence intervals; CCS — Canadian Cardiovascular Society score for angina; HF — heart failure; MACCE — major adverse cardiac and cerebrovascular events (death, myocardial infarction, stroke); NYHA — New York Heart Association for heart failure.

**Figure 2.** Cox proportional hazards cumulative survival curves with respect to different hospitalization timeframes adjusted for age, Canadian Cardiovascular Society Class (CCS) IV class for angina, diabetes, male gender, New York Heart Association (NYHA) IV class for heart failure, obesity, and active smoking.

**Figure 3.** Forest plot of risk ratios for major adverse cardiac and cerebrovascular events (death, myocardial infarction, stroke) (MACCE) (Cox proportional hazards regression model). Markers represent point estimates of risk ratios. Horizontal bars indicate 95% confidence intervals; CCS — Canadian Cardiovascular Society score for angina; HF — heart failure; NYHA — New York Heart Association for heart failure.

**Figure 4.** Cox proportional hazards freedom from MACCE curves with respect to different hospitalization timeframes adjusted for age, Canadian Cardiovascular Society Class (CCS) IV class for angina, diabetes, male gender, New York Heart Association (NYHA) IV class for heart failure, obesity, and active smoking.









