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ORIGINAL ARTICLE

Performance Measures in STEMI after COVID-19 Pandemic: Results from the RECUIMA Registry

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Abstract

Background: To offer proper medical care to patients with ST-segment Elevation Acute Myocardial Infarction (STEMI) in low- and middle-income settings (LMIS) is challenging. However, it is not known if performance indicators have changed back after the epidemiological recovery.

Objective: to describe performance measures (PM) in patients with STEMI during and after the COVID-19 pandemic.

Methods: Observational study of patients with STEMI, from an LMIS, with analysis of PM suggested in the 2017 AHA-ACC Performance Measures for Adults with STEMI. COVID-19 period was determined from January 2020 to October 2021, and from November 2021 to February 2022 as the post-COVID-19 period. Baseline characteristics, treatments and selected PM were compared using the $\chi 2$ test or Mann-Whitney U test. All tests were two-sided, and statistical significance was considered as p-value <0.05. Coronary interventionism-related PM were not reported.

Results: Administration of thrombolysis decreased (71.2% vs 51.6% (p: 0.001)), while the delay time for its administration (Median (Interquartile Range)) increased considerably (30 min (16-60) to 45 min (35- 60) (p: 0.003)). Aspirin at admission was administered in each period at 92.9% vs 94.2% (p: 0.62); and at discharge to 97.8% vs 98.9% (p: 0.48). Beta-blockers, P2Y12 inhibitors, statins, and angiotensin-converting enzyme inhibitors in patients with heart failure were administered to 67.1% vs 85.1% (p: 0.01), 96.4% vs 84% (p: 0.001), 96.2 % vs 95.7% (p: 1), and 81.2% vs 94.3% (p: 0.14), respectively.

Conclusion: Despite this being a current period of epidemiological recovery, the COVID-19 pandemic continues to negatively impact the care of patients with STEMI.

Keywords: Acute Coronary Syndrome; ST-segment Elevation Myocardial Infarction; COVID-19.

Introduction

Since the first description of COVID-19 as a pandemic, in early 2020, health systems indicators of performance changed, and these were not good changes.[1-3] Several diseases have had their prevalence rates, their symptoms, and their intrinsic risks modified[4, 5] and heart diseases were no different.[6-8]

During this event, a significant decline in hospitalization for cardiovascular events was observed during the government-enforced lockdowns in several countries.[9, 10] In this same country, a multicentric study showed that several performance measures were under accomplished in some centers, while in others, they seemed to be over fulfilled.[11] The analysis of a particular network reported that COVID-19 has negatively impacted the care of ST-segment Elevation Acute Myocardial Infarction (STEMI) patients and care givers in low / middle income settings should continuously monitor these markers in order to detect an early variation in trends.[12]

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The indirect impact of the pandemic may cause a worsening in the quality of health care services. Several difficulties appeared as pandemic continued and health systems initially failed to offer adequate assistance to, until then, common diseases. Reduced transportation availability, adaptations to infection control measures, and the segregation of hospital resources, all contributed to the loss of efficiency.[13, 14] Overlapping symptoms between chest pain and COVID-19 forced the isolation of many patients until the latter could be excluded. Precious time was lost for many of them, making some measures, such as "First Medical Contact-to-Device Time lower than 90 minutes", difficult to be met.[15]

Fortunately, in middle/late 2021, where control of pandemic begun in high income settings, (due to social isolation, lockdowns or vaccination), recovery of these health systems was reported.

Decrease of performance measures or quality markers of ST-Elevation Myocardial Infarction has been previously described in this network, in the earliest periods of the COVID-19 pandemic.[12] But it is not yet clear if the perceptible control of the pandemic has allowed better care for patients with STEMI. According to several international organizations, Cuba was ranked 3rd among those countries (more than 200,000 inhabitants) with most vaccinated population (in percentage);, however, is the one with the lowest Gross Domestic Product *per capita* among the top 30 (excluding Non-Self-Governing Territories).[16] This fact has drawn greater attention due to the fact that it was carried out with their own vaccines.

Therefore, the objective of this report was to describe performance measures of STEMI care during and after control of the COVID-19 pandemic in a network of 4 centers located in a middle-income country.

Methods

Data and population. Descriptive, observational study of patients with STEMI, from a real-world registry in a middle income setting, analyzing performance measures. The COVID-19 period was determined from January 2020 to October 2021, and from November 2021 to February 2022 as the post-COVID-19 period (the results will be presented this way).

We used data from a regional project intended to be a national registry of AMI, the RECUIMA (REgistro CUbano de Infarto Agudo de MiocArdio) project. Characteristics of this registry have been published earlier.[17] It is an initiative to collect data concerning patients with this entity. Among them, those data related to the direct care of these patients that allows a real-mode analysis.

Data are included in a professional web-based software, with a Linux server protocol and PHP user interface, and PostgreSQL database editor. There are only 4 centers included. Among them, there is a center located in a major city, which can transfer several patients weekly to a cath lab located in a center in that same city. Other 2 settings are major hospitals, heads of a state network, which can transfer less than 5% of their patients to a cath lab located in a different state, to perform a coronary intervention during hospital admission. Primary coronary interventions, or rescue coronary interventions are even scarcer. The remaining unit is a municipal hospital, located in a state of a PCI center; however, coronary interventions are rarely performed in the patients.

They all have resources to perform emergency and elective transthoracic echocardiography; no possibility of emergency coronary intervention; and absence of troponin determination – creatine kinase (CK) and creatine kinase-myocardial Band (CK-MB) are routinely performed in the central lab in the mornings, but not in the urgency lab. ST-Elevation Myocardial Infarction is generally diagnosed based on its clinical presentation, electrocardiographic and echocardiographic findings, as stated in 4th Universal Definition of Myocardial Infarction for low/middle income settings and treated mainly through thrombolysis with Recombinant Streptokinase (CIGB, La Havana).

Thus, every unit needed ethical approval from their respective responsible bureau. We conducted our study in compliance with the Declaration of Helsinki using the RECUIMA database.

Sample Selection. We included all adult patients (≥18 years of age), with STEMI from RECUIMA. Where multiple admissions for the same patient were recorded, the earlier admission was used to reduce potential bias from previous treatments.

Quality indicators. We used the 2017 American Heart Association/American College of Cardiology Clinical Performance and Quality Measures for Adults with ST-Elevation and Non–ST-Elevation Myocardial Infarction,[18] which comprises 17 performance measures. The eligibility criteria for each indicator were determined according to the specifications provided in this document. As coronary intervention were underperformed, 4 related performance measures were not studied. Also, PM-17 Early Cardiac Troponin Measurement (within 6 Hours

of Arrival), was not studied because in this particular scenario, it is not a routine practice.

Therefore, the diagnosis of ST-Elevation Myocardial Infarction was made following the specifications of the 4th Definition of Acute Myocardial Infarction for low or medium income settings.[12]

Statistical analysis. Due to the non-parametric distribution of the variables in this study (the distribution of the variables was verified using the Kolmogorov-Smirnov test), it was decided to report patient baseline characteristics, comorbidities and treatments as numbers and percentages for categorical variables, and medians and interquartile range (IQR) for continuous ones. Baseline differences, treatments and Performance Measures were tested using the $\chi 2$ test for categorical variables, and the Mann-Whitney U test for non-parametric variables. All tests were two-sided, and statistical significance was considered as a p-value <0.05. Statistical analyses were performed using the Statistical Package for Social Sciences (SPSS) Version 22..

Results

Study population. Data for 1106 patients admitted with STEMI to any of the related 4 hospitals were included. Median age was 64.4 (57–73) years, and the male sex was prevalent.

The cohort of COVID-19 period was completed by 980 patients, and 126 individuals were included in the post-COVID-19 period. Table 1 shows the demographics, comorbidities, in-hospital treatment and discharge details according to the study period and facility.

Compared with the COVID-19 era, patients admitted in post-COVID-19 period with STEMI were of similar age, and had some baseline characteristics, such as history of diabetes, renal failure, heart failure, high blood pressure, coronary artery disease and

Global Registry of Acute Coronary Events (GRACE) risk score (Table 1). Lifestyle, smoking cessation, and dietary advices are given to almost every patient and their family members during in-hospital stay, and during discharge. This information is repeated again, during follow-ups.

Finally, these institutions accomplished PM-17 ''Participation in ≥1 Regional or National registries that include patients with Acute Myocardial Infarction'', to be included in the RECUIMA Registry.

Quality of care assessment. Several QIs could not be assessed: those related with interventional procedures (23.5%) of AHA/ACC Clinical Performance and Quality

Measures for Adults with ST-Elevation Myocardial Infarction), which, unfortunately, are not performed in any of the institutions of this study.

Administration of thrombolytic therapy decreased significantly, by almost 20% (p: 0.001), while the delay time for its administration increased considerably (p: 0.003). Left Ventricular Ejection Fraction was reported in all patients, while troponin determinations were not performed, nor were patients reported with stress tests prior to discharge or referred to cardiovascular rehabilitation programs, since the gyms modified their function during the pandemic period.

The administration of aspirin, betablockers, angiotensin-converting enzyme inhibitors was lightly improved at discharge during post-COVID-19 period. However, more important performance measures such as reperfusion therapy or First medical contact - Needle time were significantly worsened compared to the COVID-19 period, as shown in Table 2.

Discussion

This report sought to describe performance measures of care in STEMI during and after control of the COVID-19 pandemic in a network of 4 centers located in a middle income country.

Initially, a decreased number of admitted STEMI patients was observed in this same area. However, in forthcoming periods, this prevalence was normalized. A recent review showed that although a decrease in the incidence of STEMI was initially observed, in the following periods, when patients began to lose their fear of the disease, they began to seek medical assistance at health centers.[19, 20]

This change in incidence caused a decrease in compliance with several indicators. In late 2020 and early 2021, when social and economic openness was attempted, only one performance measure showed an upward trend; the others decreased. Only at the end of the pandemic period, performance measures will reach values as similar as those at the beginning of this period.

In this country, some institutions started to assist exclusively patients with COVID-19, while others assumed assistance of patients from those centers, as well as their own. This caused an increase in the number of patients in some centers, as previously

Table 1 – Baseline characteristics of patients included in the study

Baseline characteristics	COVID-19 period	Post COVID-19 period	p-value
Patients	980	126	
Female sex, n (%)	293 (29.9)	39 (30.9)	0.808
Age (years), median (IQR)	64.2 (57-73)	63.3 (55-72)	0.457
Baseline characteristics			
Heart rate at hospitalization (bpm), median (IQR)	80.9 (72-88)	83.3 (75-88)	0.128
Systolic blood pressure (mm Hg), median (IQR)	131 (110-140)	132 (113-140)	0.700
Initial estimate glomerular filtration rate L/min, median (IQR)	68.1 (50.3-82.1)	70.8 (55.6-86.2)	0.339
GRACE Score			
Median (IQR)	115 (99-134)	113 (94-133)	0.466
Killip class, n (%)			
I	767 (78.3)	106 (84.1)	0.465
II	123 (12.6)	11 (8.7)	
III	23 (2.3)	3 (2.4)	
IV	67 (6.8)	6 (4.8)	
Comorbidities n (%)			
Diabetes	235 (24)	29 (23)	0.802
Current smokers	511 (52.1)	60 47.6)	0.339
Chronic heart failure	19 (1.9)	2 (1.6)	0.783
Chronic renal failure	35 (3.6)	6 (4.8)	0.854
Cerebrovascular disease	38 (3.9)	8 (6.3)	0.341
Peripheral vascular disease	22 (2.4)	3 (2.4)	0.923
Hypertension	771 (78.7)	98 (77.8)	0.818
Previous angina	243 (24.8)	27 (21.4)	0.404
In-hospital procedures n (%)			
Invasive coronary angiography	30 (3.1)	2 (1.6)	0.794
PCI	12 (1.2)	0	0.533
Aspirin	929/956 (97.2)	124/126 (98.4)	0.419
P2Y12 inhibitor	929/956 (97.2)	119/126 (94.4)	0.247
Statins	926/956 (96.9)	122/126 (96.8)	0.980
Beta blocker	569/956 (59.5)	97/126 (77)	0.001
ACEi or ARB	763/956 (79.8)	103/126 (81.7)	0.610
Lifestyle advice	Fulfilled for every patient	Fulfilled for every patient	1
Smoking cessation advice	396/507	52/60	0.053
Dietary advice	Fulfilled for every patient	Fulfilled for every patient	1

IQR: interquartile range; ACEi: Angiotensine Converter Enzyme inhibitor; ARB: Angiotensine Recepetor Blocker; PCI: Percutaneous Coronary Intervention.

Table 2 – Comparison of Performance Measures for Adults with ST-Elevation Myocardial Infarction

Performance Measures for Adults with ST-Elevation Myocardial Infarction	COVID-19 period n = 980	Post COVID-19 period n = 126	p-value
PM-1: Aspirin on arrival	910 (92.9)	119 (94.2)	0.62
PM-2: Aspirin at discharge	935 (97.8)	124 (98.9)	0.48
PM-3: beta-blocker on discharge	642 (67.1)	107 (85.1)	0.001
PM-4: high intensity statins on discharge	920 (96.2)	121 (95.7)	0.92
PM-5: Evaluation of LVEF	Fulfilled for every patient	Fulfilled for every patient	1
PM-6: ACEI or ARB for LVSD (only for patients with Estimate Glomerular Rate ≥ 15ml/min)	173 (81.2)	19 (95)	0.14
PM-7 First medical contact - Needle time	30 (16-60)	45 (35-60)	0.003
PM-9: Reperfusion Therapy	698 (71.2)	65 (51.6)	0.001
PM-13: P2Y12 Discharge inhibitor	922 (96.4)	84 (66.7)	0.001

PM: performance measures; ACEi: Angiotensine Converter Enzyme inhibitor; ARB: Angiotensine Recepetor Blocker; LVEF: Left Ventricle Ejection Fraction; LVSD: Left Ventricle Systolic Dysfunction.

reported. However, in this event, the rate of administration of thrombolysis did not change, but it increased mortality.

Even though the pharmacological approach has been suggested as primary treatment for STEMI patients during COVID-19, it did not increase its rate in these settings. As First Medical Contact time and system delay were increasing in several countries, it was assumed that fibrinolytics, or thrombolytics, might gain new indications in forthcoming waves[21, 22]. However, health systems evolve during the pandemic, and recovery of times and numbers of procedures were as high as those in late 2019. In Cuba, a multicentric study of 1000 patients reported that thrombolytics were only administered to 45% of the patients[23].

Nevertheless, they really decreased early after the pandemic period in this scenario. In Cuba, recombinant streptokinase is the only drug used in such interventions. It is likely that with the pharmaceutical industry focused on manufacturing the COVID-19 vaccines, the plans for the manufacturing of other drugs would not be fully met. The rates of administration of this reperfusion drug decreased due to the fact that other fibrinolytics, or thrombolytics were not available in this country.. The latter may be applicable to other performances measures as well.

The same phenomenon may occur with Clopidogrel administration at discharge. This drug is the only P2Y12 available in this country, so any issue with its availability will affect its use. However, in clinical guidelines there are no statements about its administration in patients without coronary intervention. Since these patients do not come from centers that perform this procedure, nor do they usually send their patients to have it performed elsewhere, there is no formal indication for its administration. However, in this country, this drug is usually recommended, although there are no studies that support it.[23, 24] Prior COVID-19 studies in this country showed that this drug was administered to almost every patient.[11, 17, 23, 24]

The time to treatment was increased as well. This seems to be a widespread phenomenon, rather than a local one.[25, 26] Most patients assisted in emergency settings need to have the disease diagnosis ruled out, to avoid spreading the infection among healthcare personnel, and this may delay some interventions. However, as the pandemic was sustained over time, several health care systems seemed able to ensure timely acute cardiac care, while still ensuring that COVID-19 protocols were respected.[27, 28]

However, in most settings of this study, where thrombolytics are administered only in a few facilities, there was an increase in treatment delivery time. In the unit where there was no such increase, in a metropolitan area, the patients were initially assisted there and therefore ischemic time was considerably shorter. Facilities that

may provide assistance to patients from large rural areas with low population density had longer total ischemic and door-to-needle times. In this same setting, just prior to the COVID-19 pandemic, a system delay time with no difference to the time of the pandemic period was reported.[12]

There were some indicators that were fully accomplished. Left ventricular ejection fraction was determined in every patient, at least at hospital admission. Since a center began to include data in RECUIMA, its protocol was adapted to perform an echocardiogram on high risk patients at their admission to the Coronary Care Unit. In low-risk patients, it was performed during in-hospital stay.

And finally, although cardiac rehab was initially reported as maintained in the early pandemic periods, adequate facilities are still underused and their full capability has not been reached yet. During the middle and late pandemic periods, they were functioning as in-hospital wards. Low availability of stress test may have had an impact on the number of admitted patients.[29, 30]

Limitations

This study has several limitations. It was carried out in a single center and was a retrospective analysis of a cohort of patients admitted in a secondary hospital in a middle income country, with a free-of-charge universal access to state-funded health care and with no private practice. Also, there were fewer patients in the Post-COVID-19 period subgroup than during the COVID-19 period. However, the latter should also be viewed as a strength: due to the continuous monitoring of health care, changes in performance measures were observed in a small cohort. This may allow to focus on changing several deficient processes, which needed urgent improving.

Finally, data prior to the COVID-19 pandemic have been previously published. To include these data into this manuscript should be interpreted as redundantinformation. Hence, the authors decided to avoid this by not mentioning those prior results.

Conclusion

Despite this being a current period of epidemiological recovery, the COVID-19 pandemic continues to negatively impact the care of STEMI patients. The number of patients submitted to reperfusion and the administration times are even worse than at the pandemic period.

Author Contributions

Conception and design of the research: Rodriguez-Ramos MA; acquisition of data: Santos-Medina M, Martinez-Garcia G, Prieto-Guerra M, Cuevas LM; analysis and interpretation of the data: Michel-Vasquez AD, Santos-Medina M, Rodriguez-Ramos MA; statistical analysis: Espinola-Zavaleta NG, Martinez-Garcia G, Prieto-Guerra M, Cuevas LM, Rodriguez-Ramos MA; writing of the manuscript: Michel-Vasquez AD, Rodriguez-Ramos MA; critical revision of the manuscript for intellectual content: Espinola-Zavaleta NG, Rodriguez-Ramos MA.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

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Ethics Approval and Consent to Participate

This article does not contain any studies with human participants or animals performed by any of the authors.

References

1. Baral P. Health Systems and Services During COVID-19: Lessons and Evidence From Previous Crises: A Rapid Scoping Review to Inform the United Nations Research Roadmap for the COVID-19 Recovery. Int J Health Serv. 2021 Oct;51(4):474-93. doi: 10.1177/0020731421997088.
2. Riera R, Bagattini ÂM, Pacheco RL, Pachito DV, Roitberg F, Ilbawi A. Delays and Disruptions in Cancer Health Care Due to COVID-19 Pandemic: Systematic Review. JCO Glob Oncol. 2021;7:311-23. doi: 10.1200/GO.20.00639.
3. Kelly JT, Campbell KL, Gong E, Scuffham P. The Internet of Things: Impact and Implications for Health Care Delivery. J Med Internet Res. 2020;22(11):e20135. doi: 10.2196/20135.
4. Pifarré I Arolas H, Vidal-Alaball J, Gil J, López F, Nicodemo C, et al. Missing Diagnoses During the COVID-19 Pandemic: A Year in Review. Int J Environ Res Public Health. 2021;18(10):5335. doi: 10.3390/ijerph18105335.

5. Moynihan R, Sanders S, Michaleff ZA, Scott AM, Clark J, To EJ, et al. Impact of COVID-19 Pandemic on Utilisation of Healthcare Services: A Systematic Review. BMJ Open. 2021;11(3):e045343. doi: 10.1136/bmjopen-2020-045343.

6. Seidu S, Kunutsor SK, Cos X, Khunti K. Indirect Impact of the COVID-19 Pandemic on Hospitalisations for Cardiometabolic Conditions and Their Management: A Systematic Review. Prim Care Diabetes. 2021;15(4):653-81. doi: 10.1016/j.pcd.2021.05.011.

7. Pellicori P, Doolub G, Wong CM, Lee KS, Mangion K, Ahmad M, et al. COVID-19 and its Cardiovascular Effects: A Systematic Review of Prevalence Studies. Cochrane Database Syst Rev. 2021;3(3):CD013879. doi: 10.1002/14651858.CD013879.

8. Harrison SL, Buckley BJR, Rivera-Caravaca JM, Zhang J, Lip GYH. Cardiovascular Risk Factors, Cardiovascular Disease, and COVID-19: An Umbrella Review of Systematic Reviews. Eur Heart J Qual Care Clin Outcomes. 2021;7(4):330-9. doi: 10.1093/ehjqcco/qcab029.

9. Furnica C, Chistol RO, Chiran DA, Stan CI, Sargu GD, Girlescu N, et al. The Impact of the Early COVID-19 Pandemic on ST-Segment Elevation Myocardial Infarction Presentation and Outcomes-A Systematic Review and Meta-Analysis. Diagnostics. 2022;12(3):588. doi: 10.3390/diagnostics12030588.

10. Altobelli E, Angeletti PM, Marzi F, D'Ascenzo F, Petrocelli R, Patti G. Impact of SARS-CoV-2 Outbreak on Emergency Department Presentation and Prognosis of Patients with Acute Myocardial Infarction: A Systematic Review and Updated Meta-Analysis. J Clin Med. 2022;11(9):2323. doi: 10.3390/jcm11092323.

11. Medina SM, Martínez JAP, García GM, Fernández MJG, Guerra MP, Pérez B, et al. Infarto agudo de miocardio en cuatro hospitales de atención secundaria en Cuba en la era COVID-19. CorSalud. 2021;13(1):1-8.

12. Rodriguez-Ramos MA. Effect of COVID-19 Pandemic on Performance Measures in Acute Myocardial Infarction. Kardiologiia. 2021;61(3):52-6. doi: 10.18087/cardio.2021.3.n1496.

13. Tam CF, Siu CD, Tse HF. Challenges in Management of ST Elevation Myocardial Infarction During COVID-19 Pandemic. Cardiol Plus. 2021;6(4):218-30. doi: 10.4103/2470-7511.334400.

14. Cameli M, Pastore MC, Mandoli GE, D'Ascenzi F, Focardi M, Biagioni G, et al. COVID-19 and Acute Coronary Syndromes: Current Data and Future Implications. Front Cardiovasc Med. 2021;7:593496. doi: 10.3389/fcvm.2020.593496.

15. Patti KG, Kohli P. COVID's Impact on Non-Communicable Diseases: What We Do Not Know May Hurt Us. CurrCardiol Rep. 2022:1-9. doi: 10.1007/s11886-022-01704-6.

16. Ritchie H, Mathieu E, Rodés-Guirao L, Appel C, Giattino C, Ortiz-Ospina E, et al. Coronavirus Pandemic (COVID-19) [Internet]. London: OurWorldInData.org; 2020 [cited 2022 Fev 12]. Available from: https://ourworldindata.org/coronavirus.

17. Martínez-García G, Rodríguez-Ramos M, Santos-Medina M, Mata-Cuevas LA, Carrero-Vázquez AM, Chipi-Rodríguez Y. Triglyceride-Glucose Index Impact on In-Hospital Mortality in Acute Myocardial Infarction. Results from the RECUIMA Multicenter Registry. Gac Med Mex. 2022;158(2):83-9. doi: 10.24875/GMM.M22000646.

18. Jneid H, Addison D, Bhatt DL, Fonarow GC, Gokak S, Grady KL, et al. 2017 AHA/ACC Clinical Performance and Quality Measures for Adults with ST-Elevation and Non-ST-Elevation Myocardial Infarction: A Report of the American College of Cardiology/American Heart Association Task Force on Performance Measures. J Am Coll Cardiol. 2017;70(16):2048-90. doi: 10.1016/j.jacc.2017.06.032.

19. Malik JA, Ahmed S, Shinde M, Almermesh MHS, Alghamdi S, Hussain A, et al. The Impact of COVID-19 On Comorbidities: A Review Of Recent Updates for Combating It. Saudi J Biol Sci. 2022;29(5):3586-99. doi: 10.1016/j.sjbs.2022.02.006.

20. Jain V, Gupta K, Bhatia K, Bansal A, Arora S, Khandelwal AK, et al. Management of STEMI During the COVID-19 Pandemic: Lessons Learned in 2020 to Prepare for 2021. Trends Cardiovasc Med. 2021;31(3):135-40. doi: 10.1016/j.tcm.2020.12.003.

21. Walters D, Mahmud E. Thrombolytic Therapy for ST-Elevation Myocardial Infarction Presenting to Non-Percutaneous Coronary Intervention Centers During the COVID-19 Crisis. Curr Cardiol Rep. 2021;23(10):152. doi: 10.1007/s11886-021-01576-2.

22. Yerasi C, Case BC, Forrestal BJ, Chezar-Azerrad C, Hashim H, Ben-Dor I, et al. Treatment of ST-Segment Elevation Myocardial Infarction During COVID-19 Pandemic. Cardiovasc Revasc Med. 2020;21(8):1024-9. doi: 10.1016/j.carrev.2020.05.027.

23. Santos-Medina M, Rodríguez-Ramos M, Prohias-Martínez J, Mata-Cuevas L, Martínez-García G, Sellen-Sanchen E, et al. REgistro CUbano de Infarto de Miocardio Agudo (RECUIMA), los primeros 1000 casos. **Rev Cuba Cardiol Cir Cardiovasc**. 2019;25(3):1-17.

24. Coll-Muñoz Y, Valladares-Carvajal F, González-Rodríguez C, Falcón-Hernandez A, Pereira-Valdés E. Infarto Agudo de Miocardio. Guía de Práctica Clínica. Rev Finlay. 2011;1(2):1-19.

25. Chew NWS, Ow ZGW, Teo VXY, Heng RRY, Ng CH, Lee CH, et al. The Global Effect of the COVID-19 Pandemic on STEMI Care: A Systematic Review and Meta-analysis. Can J Cardiol. 2021;37(9):1450-9. doi: 10.1016/j.cjca.2021.04.003.

26. Kamarullah W, Sabrina AP, Rocky MA, Gozali DR. Investigating the Implications of COVID-19 Outbreak on Systems of Care and Outcomes of STEMI Patients: A Systematic Review and Meta-Analysis. Indian Heart J. 2021;73(4):404-12. doi: 10.1016/j.ihj.2021.06.009.

27. Fernando H, Dinh D, Duffy SJ, Brennan A, Sharma A, Clark D, et al. Rescue PCI in the Management of STEMI: CONTEMPORARY results from the Melbourne Interventional Group Registry. Int J Cardiol Heart Vasc. 2021;33:100745. doi: 10.1016/j.ijcha.2021.100745.

28. Lopez JJ, Ebinger JE, Allen S, Yildiz M, Henry TD. Adapting STEMI Care for the COVID-19 Pandemic: The Case for Low-Risk STEMI Triage and Early Discharge. Catheter Cardiovasc Interv. 2021;97(5):847-9. doi: 10.1002/ccd.28993.

29. Nan J, Zhang T, Tian Y, Song K, Li Q, Fu Q, et al. Impact of the 2019 Novel Coronavirus Disease Pandemic on the Performance of a Cardiovascular Department in a Non-Epidemic Center in Beijing, China. Front Cardiovasc Med. 2021;8:630816. doi: 10.3389/fcvm.2021.630816.

30. Medranda GA, Brahmbhatt K, Alawneh B, Marzo KP, Schwartz RK, Green SJ. Initial Single-Center ST-Segment Elevation Myocardial Infarction Experience in New York Before and During the COVID-19 Pandemic. Cardiovasc Revasc Med. 2022;34:80-5. doi: 10.1016/j.carrev.2021.01.026.