Managed Care after Acute Myocardial Infarction (MC-AMI) improves prognosis in AMI survivors with pre-existing heart failure: A propensity score matching analysis of Polish nationwide program of comprehensive post-MI care

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ABSTRACT

Background: Despite improvement in acute myocardial infarction (AMI) treatment, post-discharge mortality remains high. The outcomes are supposed to be even worse in patients with post-MI heart failure (HF), as only a half of patients with newly diagnosed HF survive four years.

Aims: The study aimed to analyze whether managed care after acute myocardial infarction (MC-AMI) is associated with better survival in AMI survivors with a pre-existing diagnosis of HF.

Results: The study included 7228 patients with a pre-existing diagnosis of HF who survived the hospitalization for AMI in Poland between November 2017 and December 2020, of whom 2268 (31.4%) were referred for the MC-AMI program. The median follow-up was 1.5 (0.7–2.3) years. In the unmatched analysis, patients without MC-AMI had more than twice higher 12-month mortality (21.8% vs. 9.9%; *P* <0.01) than MC-AMI participants. The difference remained significant after propensity score matching (16,8% vs. 10.0%; *P* <0.01). In multivariable analysis, participation in MC-AMI was an independent factor of 12-month survival. MC-AMI participants had a lower stroke rate (1.5% vs. 3.0%; *P* <0.01) and fewer hospital admissions due to HF (22.9% vs. 27.6%; *P* <0.01).

Conclusions: After propensity score matching, participation in MC-AMI was associated with lower rates of stroke, HF hospitalizations, and all-cause mortality in the 12-month follow-up and was an independent factor of 12-month survival in AMI survivors with pre-existing HF.

Key words: acute myocardial infarction, heart failure, managed care, survival

WHAT'S NEW?

The post-discharge period, also called the transition phase, is the most vulnerable in heart failure (HF) patients. For that reason, we aimed to analyze whether managed care after acute myocardial infarction (MC-AMI) is associated with better survival in AMI survivors with a pre-existing diagnosis of HF. Our study proved in propensity score matching analysis that participation in MC-AMI was associated with lower rates of stroke, HF hospitalizations, and all-cause mortality in a 12-month follow-up and was an independent factor of 12-month survival in AMI survivors with pre-existing HF.

INTRODUCTION

In recent years, an improvement in the treatment and in-hospital prognosis of myocardial infarction has been observed. However, the post-discharge mortality remains high, especially in patients with post-MI heart failure (HF), as only half of patients with newly diagnosed HF survive four years [1, 2]. The post-discharge period, also called the transition phase, is the most vulnerable in HF patients [3]. For that reason, the proposed interventions aimed to improve survival, including out-patient visits scheduled in the first days after discharge or early post-discharge multidisciplinary team management [1, 4]. It has already been demonstrated in previous studies from our database that managed care after acute myocardial infarction (MC-AMI) improves 12-month survival [5, 6]. Other studies on managed care programs after AMI revealed different results [7, 8]. For that reason, we aimed to analyze whether MC-AMI is associated with better survival in AMI survivors with pre-existing HF.

METHODS

The study is a retrospective analysis of data from the SILesian CARDiovascular (SILCARD) registry. General information on the SILCARD database was previously reported [9, 10]. The database contains records from all hospitals (n = 310) in the Silesian Province — a large administrative region in Southern Poland with 4.57 million citizens. The SILCARD database enrolled all consecutive Silesian adults admitted to the cardiology, cardiac surgery, vascular surgery, diabetology units for any reason, or hospitalized in the internal medicine or intensive care units with the principal diagnosis of cardiovascular disease (CVD). CVD was defined as R52 or J96 or any "I" code according to the 10th revision of the International Classification of Disease (ICD-10).

MC-AMI is Poland's National Health Fund and Ministry of Health program implemented to improve hospital and post-discharge care in AMI patients. The program was designed as a comprehensive plan composed of four core modules: I — hospitalization and acute intervention according to ESC guidelines, II — cardiac rehabilitation, III — implantation of implantable cardioverter defibrillators (ICD) or chronic resynchronization therapy (CRT-D) in eligible subjects, and IV — post-discharge scheduled out-patient cardiology care (at least four visits over 12 months).

The study included consecutive adult patients hospitalized due to AMI in Silesia between November 2017 and December 2020 and pre-existing diagnosis of HF, who survived ten days after discharge. The ten days were chosen because of the median time from hospital discharge to MC-AMI to exclude patients who died before the onset of the MC-AMI program. The follow-up was measured from the hospital discharge in patients who were discharged alive. Patients were divided into two groups: participating in MC-AMI and subjects in a control group. The control group included AMI patients hospitalized in the same period who did not consent for participation in MC-AMI.

The Bioethics Committee of the Medical University of Silesia approved the SILCARD database analyses (PCN/0022/KB/49/21).

Statistical analysis

The normality of the continuous variables was tested using the Shapiro-Wilk test. Variables with normal distribution were presented as means and SD and those with skewed distribution as medians and interquartile ranges (IQR). Categorical variables were shown as percentages. Baseline characteristics, medical history, and in-hospital interventions were compared using Student's t-test (for normally distributed variables), the nonparametric Mann-Whitney U test for continuous variables without normal distribution, and the $\chi 2$ test for categorical variables data with Yates' correction if applicable. After 1:1 propensity score matching, two groups of patients were also compared. Multivariable analysis was also performed to identify independent risk factors for all-cause death in a 12-month follow-up from the beginning of the MC-AMI program. The forward stepwise regression was used with all available parameters included in the model, and statistical significance was defined as P <0.05. The Kaplan-Meier plots were drawn to visualize the survival curves. All statistical analyses were performed using TIBCO Statistica 13 software.

RESULTS

The study included 7228 patients with AMI and pre-existing diagnosis of HF, of whom 2268 (31.4%) were referred for MC-AMI treatment. The median follow-up was 1.5 (0.7–2.3) years.

Compared to the control group, patients in the MC-AMI program were younger, more often had a history of PCI and PCI and bleeding during the current hospitalization but less often a history of stroke and atrial fibrillation in the past (Table 1). In the unmatched analysis, patients without MC-AMI qualification had more than twice higher 12-month mortality (21.8% vs. 9.9%; P <0.01) (Figure 1). The difference remained significant after propensity score

Table 1. Baseline characteristics regarding qualification for MC-AMI before and after matching

	Before matching			After matching		
	MC-AMI – n = 4960	MC-AMI + n = 2268	*P*-value	MC-AMI – n = 2221	MC-AMI + n = 2221	*P*-value
Age, years, mean (SD)	74.9 (10.2)	71.7 (9.7)	<0.01	72.2 (9.9)	72.0 (9.4)	0.67
Follow-up, years, median (IQR)	1.5 (0.6–2.3)	1.4 (0.7–2.1)	0.28	1.6 (0.7–2.4)	1.4 (0.7–2.1)	<0.01
Female sex, n (%)	2208 (44.5)	850 (37.5)	<0.01	843 (38.0)	840 (37.8)	0.95
STEMI, n (%)	944 (19.0)	480 (21.2)	0.04	461 (20.8)	464 (20.9)	0.94
History of hypertension, n (%)	4636 (93.5)	2140 (94.4)	0.16	2,100 (94.6)	2095 (94.3)	0.79
History of diabetes, n (%)	2644 (53.3)	1195 (52.7)	0.64	1188 (53.5)	1176 (52.9)	0.74
History of MI, n (%)	1965 (39.6)	925 (40.8)	0.36	915 (41.2)	906 (40.8)	0.81
History of pulmonary edema, n (%)	269 (5.4)	98 (4.3)	0.06	93 (4.2)	95 (4.3)	0.94
History of PCI, n (%)	1752 (35.3)	873 (38.5)	0.01	859 (38.7)	849 (38.2)	0.78
History of BMS implantation, n (%)	417 (8.4)	185 (8.2)	0.76	189 (8.5)	184 (8.3)	0.83
History of DES implantation, n (%)	1198 (24.2)	607 (26.8)	0.02	609 (27.4)	587 (26.4)	0.48
History of CABG, n (%)	452 (9.1)	235 (10.4)	0.1	226 (10.2)	231 (10.4)	0.84
History of valvular surgery, n (%)	123 (2.5)	51 (2.2)	0.61	54 (2.4)	49 (2.2)	0.69
History of PM implantation, n (%)	342 (6.9)	121 (5.3)	0.01	117 (5.3)	121 (5.4)	0.84
History of ICD implantation, n (%)	252 (5.1)	92 (4.1)	0.07	92 (4.1)	90 (4.1)	0.94
History of CRT-P/CRT-D, n (%)	75 (1.5)	27 (1.2)	0.33	26 (1.2)	27 (1.2)	0.99
History of ablation, n (%)	55 (1.1)	22 (1.0)	0.68	23 (1.0)	21 (0.9)	0.88
History of AF, n (%)	1469 (29.6)	589 (26.0)	<0.01	606 (27.3)	582 (26.2)	0.44
History of VT/VF/cardiac arrest, n (%)	180 (3.6)	78 (3.4)	0.74	75 (3.4)	77 (3.5)	0.93
Other arrhythmias, n (%)	2025 (40.8)	848 (37.4)	<0.01	851 (38.3)	837 (37.7)	0.69
History of COPD, n (%)	1179 (23.8)	517 (22.8)	0.38	509 (22.9)	511 (23.0)	0.97
History of asthma, n (%)	924 (18.6)	423 (18.7)	0.99	427 (19.2)	415 (18.7)	0.67
History of CKD, n (%)	784 (15.8)	307 (13.5)	0.01	292 (13.1)	302 (13.6)	0.69
History of RRT, n (%)	133 (2.7)	43 (1.9)	0.05	47 (2.1)	42 (1.9)	0.67
History of stroke, n (%)	801 (16.1)	290 (12.8)	<0.01	286 (12.9)	290 (13.1)	0.89
History of PAD, n (%)	236 (4.8)	91 (4.0)	0.18	81 (3.6)	90 (4.1)	0.53
History of cancer, n (%)	2068 (41.7)	990 (43.7)	0.12	964 (43.4)	967 (43.5)	0.95
Coronary angiography, n (%)	4012 (80.9)	2.254 (99.4)	<0.01	2,207 (99.4)	2,207 (99.4)	0.85
PCI, n (%)	2800 (56.5)	2012 (88.7)	<0.01	1970 (88.7)	1965 (88.5)	0.85
IABP, n (%)	64 (1.3)	19 (0.8)	0.12	41 (1.8)	18 (0.8)	<0.01
PM implantation, n (%)	109 (2.2)	28 (1.2)	<0.01	54 (2.4)	27 (1.2)	<0.01
ICD implantation, n (%)	52 (1.0)	5 (0.2)	<0.01	19 (0.9)	5 (0.2)	<0.01
CRT-P/CRT-D implantation, n (%)	16 (0.3)	6 (0.3)	0.85	4 (0.2)	6 (0.3)	0.75
Valvular surgery, n (%)	48 (1.0)	6 (0.3)	<0.01	13 (0.6)	6 (0.3)	0.17
Hospitalization in ICU, n (%)	392 (7.9)	91 (4.0)	<0.01	157 (7.1)	91 (4.1)	<0.01
Bleeding requiring blood transfusion, n (%)	662 (13.3)	153 (6.7)	<0.01	245 (11.0)	150 (6.8)	<0.01

Abbreviations: AF, atrial fibrillation; BMS, bare metal stent; CABG, coronary artery bypass Grafting; CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease; CRT-D, cardiac resynchronization therapy defibrillator; CRT-P, cardiac resynchronization therapy pacemaker; DES, drug-eluting stent; HF, heart failure; IABP, intra-aortic balloon pump; ICD, implantable cardioverter defibrillator; ICU, intensive care unit; MC-AMI, managed care after acute myocardial infarction; MI, myocardial infarction; PAD, peripheral artery disease; PCI, percutaneous coronary intervention; PM, pacemaker; RRT, renal replacement therapy; SD, standard deviation; STEMI, ST-segment elevation myocardial infarction; VF, ventricular fibrillation; VT, ventricular tachycardia

matching (16.8% vs. 10.0%; $P<0.01$) (Table 2). Participation in the MC-AMI program was an independent factor of 12-month survival in multivariable analysis (Table 3). MC-AMI has also been associated with a reduction in the rates of stroke and hospital admission due to HF.

DISCUSSION

We showed that participation in MC-AMI is associated with better 12-month survival in patients after AMI with pre-existing HF. A reduction in mortality rates was associated with a reduction in stroke and HF hospitalization rates. Interestingly, during the 12-month follow-up, there were no differences in coronary angiography, PCI, and ICD implantation rates between the groups. For that reason, the possible explanations of the positive impact of MC-AMI were improved ambulatory care (number of AOS visits) and rehabilitation after discharge. Participation in MC-AMI was also associated with a higher cost of treatment during the 12-month follow-up. Higher costs of hospital stay in MC-AMI participants might suggest that the course of AMI could be more complicated, influencing the costs of post-discharge care. To the best of our knowledge, our

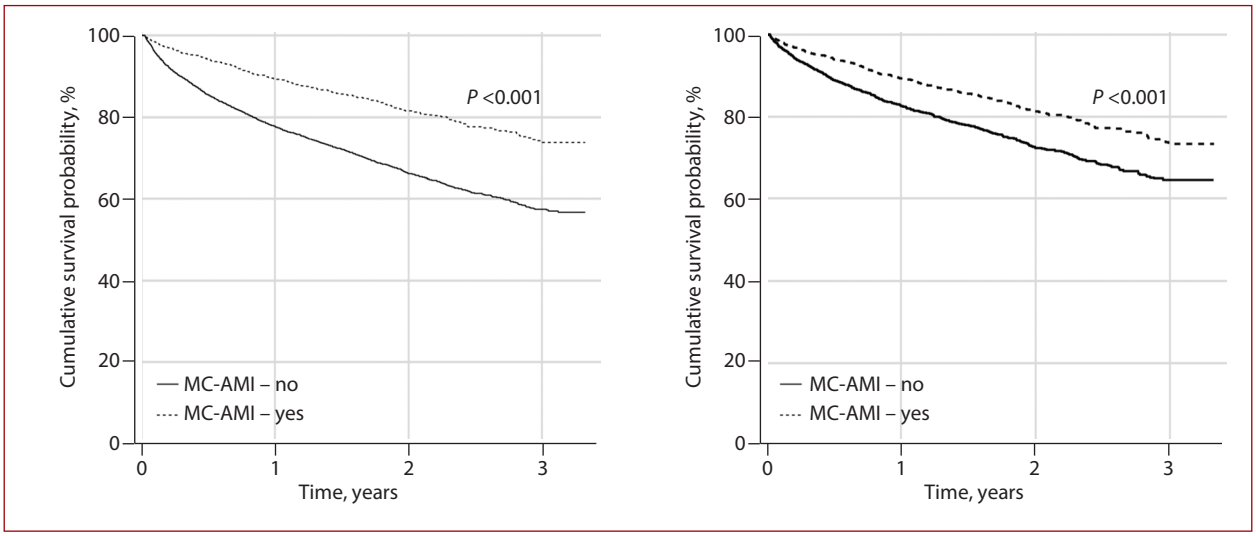

Figure 1. Comparison of survival in MC-AMI and non-MC-AMI groups before (left) and after (right) propensity score matching — Kaplan-Meier curves

Table 2. Events and outcomes in a 12-month follow-up regarding the MC-AMI attendance before and after matching

	Before matching			After matching		
	MC–AMI – n = 4960	MC–AMI + n = 2268	*P*-value	MC-AMI – n = 2221	MC-AMI + n = 2221	*P*-value
All-cause death, n (%)	886 (21.8)	165 (9.9)	<0.01	304 (16.8)	164 (10.0)	<0.01
Coronary angiography, n (%)	682 (16.8)	351 (21.0)	0.06	386 (21.3)	338 (20.6)	0.06
PCI, n (%)	485 (11.9)	272 (16.2)	<0.01	293 (16.2)	259 (15.8)	0.13
Stroke, n (%)	120 (2.9)	25 (1.5)	<0.01	54 (3.0)	24 (1.5)	<0.01
Rehabilitation, n (%)	822 (20.2)	1096 (65.4)	<0.01	461 (25.5)	1,076 (65.5)	<0.01
Hospitalization due to HF, n (%)	1215 (29.9)	378 (22.6)	<0.01	499 (27.6)	375 (22.9)	<0.01
Atrial fibrillation, n (%)	576 (14.2)	196 (11.7)	<0.01	239 (13.2)	194 (11.8)	0.03
PM implantation, n (%)	64 (1.6)	42 (2.5)	0.02	35 (1.9)	42 (2.6)	0.26
ICD implantation, n (%)	142 (3.5)	79 (4.7)	0.03	92 (5.1)	78 (4.8)	0.71
CRT-D implantation, n (%)	66 (1.6)	52 (3.1)	<0.01	33 (1.8)	51 (3.1)	0.02
GP visits per patient per year, median (IQR)	10 (5–16)	9 (5–14)	<0.01	10 (6-16)	9 (5-14)	<0.01
OHC visits per patient per year, median (IQR)	0 (0–2)	3 (1–5)	<0.01	1 (0-2)	3 (1-5)	<0.01
Cost of hospitalization, PLN, median (IQR)	9610 (0–13 342)	10679 (9718–15 227)	<0.01	10 571 (9610–14 943)	10 679 (9718–15 227)	<0.01
Cost of treatment during the 12-month follow-up, median, PLN, median (IQR)	316 (0–3610)	5547 (2276–8371)	<0.01	445 (36–4004)	5546 (2233–8351)	<0.01
Bleeding requiring blood transfusion, n (%)	662 (13.3)	153 (6.7)	<0.01	245 (11.0)	150 (6.8)	<0.01

Abbreviations: see Table 1

Table 3. Multivariable analysis of 12-month post-discharge mortality

	HR (95% CI)	*P*-value
RRT	1.85 (1.45–2.35)	<0.01
History of pulmonary oedema	1.43 (1.20–1.70)	<0.01
History of PAD	1.38 (1.14–1.67)	<0.01
History of diabetes	1.34 (1.22–1.47)	<0.01
Female gender	1.27 (1.15–1.40)	<0.01
MC-AMI	1.25 (1.09–1.42)	<0.01
STEMI	1.24 (1.11–1.40)	<0.01
History of CKD	1.20 (1.06–1.36)	<0.01
History of stroke	1.20 (1.07–1.35)	<0.01
Age, (per 5 years increase)	1.15 (1.12–1.18)	<0.01
History of COPD	1.15 (1.03–1.27)	0.01
PCI	0.61 (0.54–0.68)	<0.01
Rehabilitation after discharge	0.51 (0.45–0.58)	<0.01

Abbreviations: HR, hazard ratio; other — see Table 1

study is the first one that showed the benefits of managed care in AMI survivors with pre-existing HF.

In our previous studies, participation in MC-AMI was associated with the reduction of MACE and MACCE rates in a 3- and 12-month follow-up, respectively, and lower all-cause mortality in 12-month observation [6, 11, 12]. Different approaches to post-discharge care in AMI patients were implemented in other countries. In Germany, nurse-based management among elderly patients after AMI had no significant impact on the mortality rate in a one-year follow-up [8]. In another trial, the disease management program improved the adherence to guideline-recommended medication, health care expenditures, and survival [7]. More evidence regarding post-discharge care is available in HF. According to the recent HF guidelines of the European Society of Cardiology, patients with HF should be enrolled in a multidisciplinary care management program to reduce the risk of HF hospitalization and mortality [1]. Reduced left ventricular ejection fraction is diagnosed in 18%–20% of patients discharged after AMI [13]. Thus, early post-discharge care is essential to reduce mortality and the probability of recurrent AMI and hospitalizations for acute HF. Patients after AMI with pre-existing HF seem to be at the highest risk of death or rehospitalization. Participation in MC-AMI resulted in the reduction of hospital readmission and mortality in our cohort. We have no data to present the importance of the particular MC-AMI components (education, ambulatory care, rehabilitation, and primary prevention of sudden cardiac death) in achieving the overall result. A decrease in the prevalence of stroke was an additional observation. It might be explained by better detection of atrial fibrillation in patients in MC-AMI and possibly better drug compliance in patients with more ambulatory visits. The atrial fibrillation rate after AMI was about 10% lower while the prevalence of stroke was 50% lower in the MC-AMI group.

Study limitations

Our study was designed as a retrospective analysis of a large, nationwide registry, which does not provide data on blood test results and pharmacological treatment during hospitalization and after discharge. Thus, propensity score matching did not include these parameters.

To conclude, participation in MC-AMI was associated with lower rates of stroke, HF hospitalizations, and all-cause mortality in a 12-month follow-up and was an independent factor of 12-month survival in AMI survivors with pre-existing heart failure.

Article information

Conflict of interest: None declared.

REFERENCES

1. Seferovic PM, Ponikowski P, Anker SD, et al. 2016 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure: The Task Force for the diagnosis and treatment of acute and chronic heart failure of the European Society of Cardiology (ESC)Developed with the special contribution of the Heart Failure Association (HFA) of the ESC. Eur Heart J. 2016; 37(27): 2129–2200, doi: 10.1093/eurheartj/ehw128, indexed in Pubmed: 27206819.
2. McDonagh T, Metra M, Adamo M, et al. Corrigendum to: 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure: Developed by the Task Force for the diagnosis and treatment of acute and chronic heart failure of the European Society of Cardiology (ESC) With the special contribution of the Heart Failure Association (HFA) of the ESC. Eur Heart J. 2021; 42(48): 4901–4901, doi: 10.1093/eurheartj/ehab670, indexed in Pubmed: 34447992.
3. Desai AS, Stevenson LW, Stewart GC, et al. Patient expectations from implantable defibrillators to prevent death in heart failure. J Card Fail. 2010; 16(2): 106–113, doi: 10.1016/j.cardfail.2009.09.003, indexed in Pubmed: 20142021.
4. Batten A, Jaeger C, Griffen D, et al. See You in 7: improving acute myocardial infarction follow-up care. BMJ Open Qual. 2018; 7(2): e000296, doi: 10.1136/bmjoq-2017-000296, indexed in Pubmed: 30019011.
5. Jankowski P, Topór-Mądry R, Gąsior M, et al. Innovative managed care may be related to improved prognosis for acute myocardial infarction survivors. Circ Cardiovasc Qual Outcomes. 2021; 14(8): e007800, doi: 10.1161/CIRCOUTCOMES.120.007800, indexed in Pubmed: 34380330.
6. Wita K, Kułach A, Wita M, et al. Managed Care after Acute Myocardial Infarction (KOS-zawał) reduces major adverse cardiovascular events by 45% in 3-month follow-up - single-center results of Poland's National Health Fund program of comprehensive post-myocardial infarction care. Arch Med Sci. 2020; 16(3): 551–558, doi: 10.5114/aoms.2019.85649, indexed in Pubmed: 32399102.
7. Kirsch F, Becker C, Schramm A, et al. Patients with coronary artery disease after acute myocardial infarction: effects of continuous enrollment in a structured Disease Management Program on adherence to guideline-recommended medication, health care expenditures, and survival. Eur J Health Econ. 2020; 21(4): 607–619, doi: 10.1007/s10198-020-01158-z, indexed in Pubmed: 32006188.
8. Meisinger C, Stollenwerk B, Kirchberger I, et al. Effects of a nurse-based case management compared to usual care among aged patients with myocardial infarction: results from the randomized controlled KORINNA study. BMC Geriatr. 2013; 13: 115, doi: 10.1186/1471-2318-13-115, indexed in Pubmed: 24168465.
9. Gąsior M, Pres D, Wojakowski W, et al. Causes of hospitalization and prognosis in patients with cardiovascular diseases Secular trends in the years 2006–2014 according to the SILesian CARDiovascular (SILCARD) database. Pol Arch Med Wewn. 2016; 126(10): 754–762, doi: 10.20452/pamw.3557, indexed in Pubmed: 27650214.
10. Niedziela JT, Parma Z, Pawlowski T, et al. Secular trends in first-time hospitalization for heart failure with following one-year readmission and mortality rates in the 3.8 million adult population of Silesia, Poland between 2010 and 2016. The SILCARD database. Int J Cardiol. 2018; 271: 146–151, doi: 10.1016/j.ijcard.2018.05.015, indexed in Pubmed: 30223348.
11. Wita K, Wilkosz K, Wita M, et al. Managed Care after Acute Myocardial Infarction (MC-AMI) — a Poland's nationwide program of comprehensive post-MI care - improves prognosis in 12-month follow-up. Preliminary experience from a single high-volume center. Int J Cardiol. 2019; 296: 8–14, doi: 10.1016/j.ijcard.2019.06.040, indexed in Pubmed: 31256995.
12. Wybraniec MT, Mizia-Stec K, Gąsior Z, et al. Long-term effects of the Managed Care After Acute Myocardial Infarction program: an update on a complete 1-year follow-up. Kardiol Pol. 2020; 78(5): 458–460, doi: 10.33963/KP.15256, indexed in Pubmed: 32406217.
13. Gasior M, Gierlotka M, Pyka Ł, et al. Temporal trends in secondary prevention in myocardial infarction patients discharged with left ventricular systolic dysfunction in Poland. Eur J Prev Cardiol. 2018; 25(9): 960–969, doi: 10.1177/2047487318770830, indexed in Pubmed: 29692221.