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Analysis of the information about the incidence of heart failure, associated mortality and burden on the healthcare system, based on the encoding data in 15 subjects of the Russian Federation

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Aim. This study aims to assess the incidence of heart failure (HF) and associated mortality, and also the burden on the healthcare system in the subjects of Russian Federation, based on the HF encoding data.

Material and methods. We made a structured request for the number of patients with HF and the number of cases of providing medical care in 2019. HF was understood to mean the presence of at least one of the codes I09.9, I11.0, I13.0, I13.2, I25.5, I42.0, I42.5, I42.6, I42.7, I42.8, I42.9, I43.0, I43.1, I43.2, I43.8, I50.x (expanded encoding) according to International Classification of Diseases 10th Revision. The code I50.x was considered separately (the standard HF enconding).

Results. The information about the incidence of HF, associated mortality and burden on the healthcare system was obtained from 15 subjects (53,6% from those that gave the data according to the request; the adult population is 18,9% from total adult population of Russian Federation). We noted significant heterogeneity between the regions. The median of the incidence of HF and associated mortality was 2,6 and 3,2% in accordance with the data of the expanded encoding, and 0,21 and 11,3% — according to the standard HF encoding. The presence of the code I50.x was observed in average in 9,4% of all cases of HF and defined the patients who frequently used emergency medical services and were frequently hospitalized (60 (18, 96) and 48 (20, 137) cases per 100 patients versus 9 (5, 24) and 17 (10, 70) cases in the expanded encoding).

Conclusion. According to the encoding, the indicators of the incidence of HF and associated mortality vary greatly between the regions, the median values are 2,6 and 3,2% in expanded and 0,21 and 11,3% in standard approaches. In the standard encoding, there were more frequent use of emergency medical services and less number of outpatient visits. The development and introduction of a unified approach to encoding and recording the cases of HF will provide obtaining objective statistical data and using them for management decisions.

Keywords: heart failure, ICD codes, incidence, load, burden on the healthcare system, prognosis.

Relationships and Activities: none.

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Among a wide range of cardiovascular diseases (CVDs) heart failure (HF) is characterized by the highest risk of death, which reaches 12 and 43% in case of the presence of the symptoms and in case of hospitalization with HF decompensation, respectively [1, 2]. The decrease in mortality rate of patients with HF is potentially the most effective strategy to achieve the goal of federal project "Fight against cardiovascular diseases" by 2030. The project actively discusses the transformations in the system of the organization of medical care and the preferential drug provision of patients with HF, contributing to the improvement of the patients` prognosis [3-6]. It was showed that in ideal conditions of randomized clinical trials, the modern classes of drugs significantly reduce the risk of the HF development and progression, and their combination in patients with HF and low left ventricular ejection fraction (EF) can provide more than two times decrease in general mortality [7]. The additional risk reduction of recurrent hospitalizations for worsening HF and death can be achieved due to multidisciplinary monitoring programs [8]. Planning needs, economic justification and evaluation of subsequent effectiveness in the implementation of these strategies in routine practice is hampered by the lack of data on the epidemiology of HF in the Russian Federation (RF). In the absence of a system of centralized collection of statistical information on HF at the level of regions and the country as a whole [9, 10] and a fully functioning segment "Heart failure" of the vertically integrated medical information system "Cardiovascular diseases" (VIMIS CVD), one of the initial methods for assessing the epidemiology of HF can be the analysis of the frequency of use of codes according to the International Classification of Diseases (ICD) for the list of diseases associated with a high probability of the presence/development of HF. This approach is widely used abroad. The possibility to use the encoding for the studies at the population level is emphasized by the data of the systematic review and meta-analysis [11]. The HF encoding has showed 96,8% specificity and 75,3% sensitivity in relation to the HF diagnosis established during thorough analysis of medical history, the use of symptomatic Framingham criteria 1971 (positive predictive significance up to 94,3%), EF values ⩽55% (specificity 99,5%), criteria of the European Society of Cardiology 1995 (specificity up to 86%) [11]. Since the modern algorithm of HF diagnostics is quite complicated and in particular it may include the invasive estimation of hemodynamics during loading, the scientifically-based possibility of using a simplified approach to assessing epidemiology based on encoding data is of special importance.

Previously, we performed a study aimed to investigate the regional integrated database of electronic medical records of Saint-Petersburg, which was based on the accounting for the ICD codes that potentially characterize the presence of HF, where we obtained the value of the HF prevalence comparable with average European value (1,4 vs 1,7% in Europe) [9, 12]; however, it significantly differed from the assumed prevalence of HF in the European part of the Russian Federation according to the EPOKHA (ЭПОХА) research (7%) [13]. Taking into account the differences in the population characteristics, prevalence and mortality from CVDs and in the features of the medical care organization, it is interesting to perform the similar study in other subjects of RF, in particular, to obtain the information about the possibilities in accounting and assessing the burden of HF for the country as a whole.

The study is aimed to assess the prevalence and lethality in HF as well as the burden on the healthcare system in the regions of RF based on the data of the HF encoding.

Material and methods

We made a structured request to the executive authorities in the healthcare field of 40 subjects of the Russian Federation of the Northwestern, Southern, North Caucasian and Volga Federal districts supervised by V. A. Almazov National Medical Research Centre of the Ministry of Health of the Russian Federation within the framework of the federal project "Development of a network of national medical research centers and the introduction of innovative medical technologies". The structure of the request included the number of the

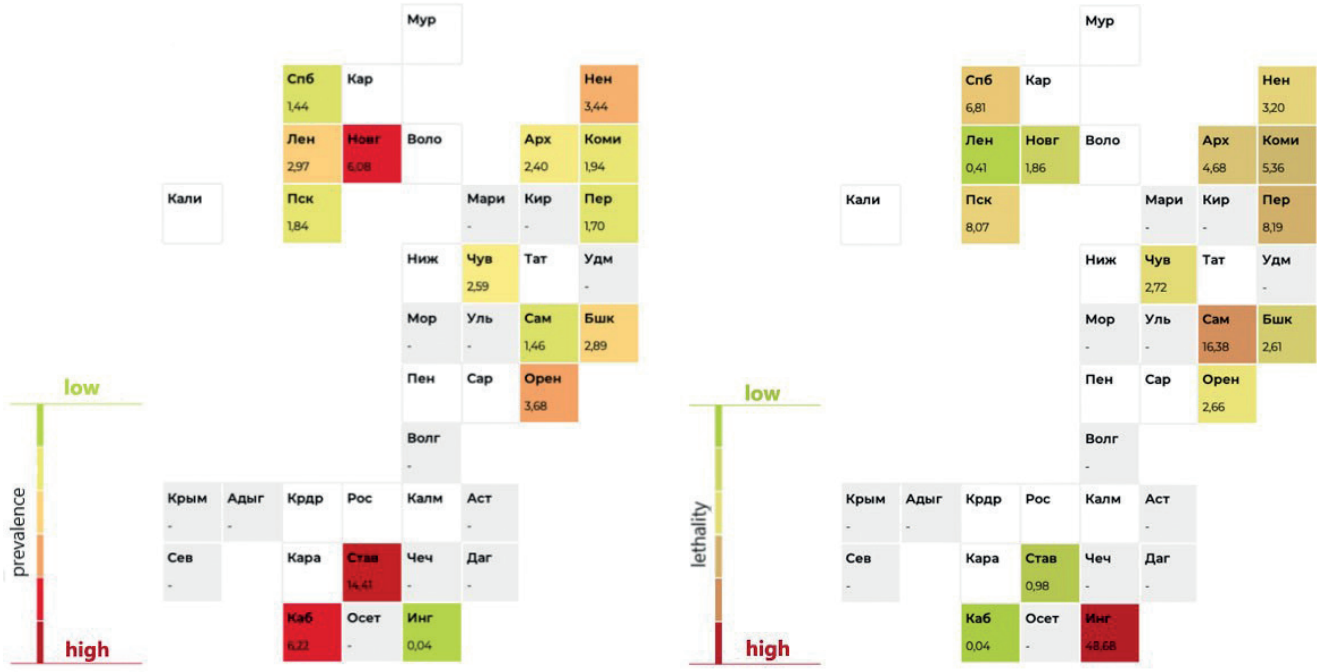

Figure 1. Tile diagrams with gradation of prevalence (**A**) and mortality (**B**) values for HF, established according to encoding data (as a percentage) in the supervised regions. White indicates the regions which did not respond to the request. Grey — regions that did not provide the data on the parameters.

patients and cases of providing medical care in 2019, when at least one of the ICD-10 codes was used in the diagnosis: I09.9, I11.0, I13.0, I13.2, I25.5, I42.0, I42.5, I42.6, I42.7, I42.8, I42.9, I43.0, I43.1, I43.2, I43.8, I50.x (expanded encoding) [9]. The patients with the presence of at least one of these codes were considered as the patients with HF. The indicators with the presence of at least on code I50.x in the diagnosis were considered separately (standard encoding). We made an additional request for the data on the number of adults, the number of cases of seeking medical care among the adult population, including hospitalizations, visits to polyclinics, ambulance calls, deaths in 2019.

Statistical processing of the results was carried out using a software package Stata 16.0 (StataCorp, College Station, TX, USA). Incidence was calculated as the ratio of the number of cases of HF to the adult population for the beginning of 2019; mortality — as the ratio of the number of died people diagnosed with HF to the total number of patients with HF. The indicators were evaluated in groups in the presence of at least one of the analyzed codes and separately in the presence of codes I50.x. Taking into account the small sample size, the data were presented in the form of median and interquartile range (IQR, 25 and 75 percentiles) and absolute numbers (proportions).

The study was performed in accordance with the standards of Good Clinical Practice and the principles of the Declaration of Helsinki.

Results

The information according to the request was received from 28 of 40 subjects of RF, supervised by V.A. Almazov National Medical Research Centre of the Ministry of Health of the Russian Federation. The response was 70%. The total adult population of the subjects of the Russian Federation who responded to the request was 36085763 people in 2019, that corresponds to 31% of the total adult population of the country. The completeness of the response to the request (the proportion of the received indicators from the requested indicators) varied from 13,8 to 100%. Three regions used the data of electronic medical cards as the source of the information, and in other cases — the data of the territorial fund of compulsory medical insurance of subjects.

The data of the prevalence and lethality while using the ICD-10 codes that potentially characterize the presence of HF, were obtained from 15 regions

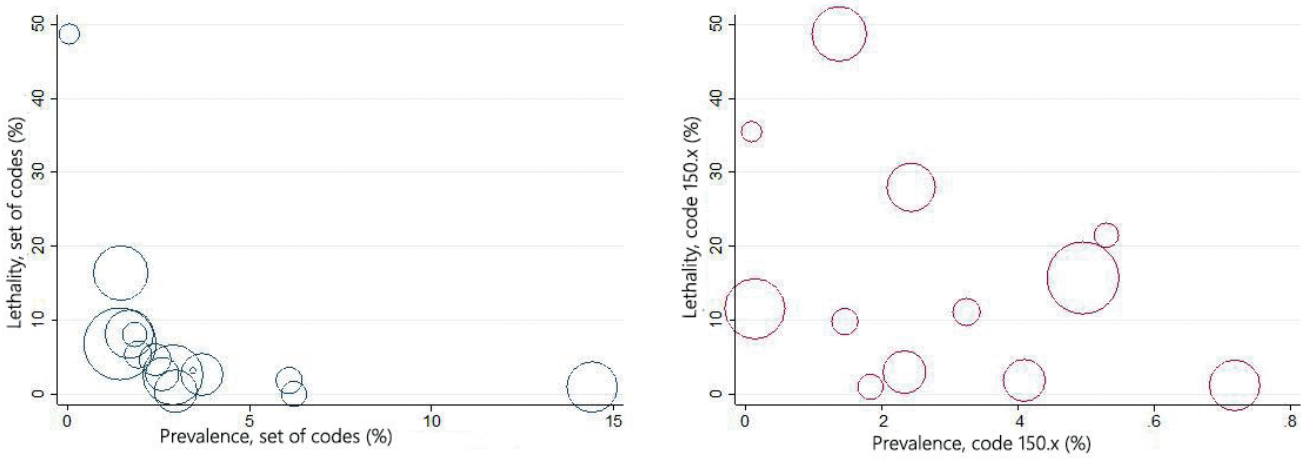

Figure 2. Scatter diagrams of the values of the prevalence of HF and lethality in HF, established according to encoding data, with a weighting factor equal to the proportion of the adult population in a subject of the Russian Federation in relation to the adult population of the Russian Federation as a whole. **A** — expanded encoding, **B** — standard encoding.

Table 1

Indicators of burden on healthcare system, associated with HF

Indicator of burden on healthcare system, associated with HF	Standard encoding	Expanded encoding
Proportion among all seeking medical care, %	0,10 (0,04, 0,18)	0,91 (0,47, 4,04)
Proportion among ambulance calls, %	0,43 (0,06, 0,81)	0,92 (0,40, 2,64)
Proportion among hospitalizations for any reason, %	0,31 (0,03, 0,48)	1,50 (0,98, 5,09)
Proportion among outpatient visits, %	0,02 (0,004, 0,06)	0,77 (0,31, 2,53)
Number of seeking medical care per 100 patients	98 (49, 136)	170 (122, 217)
Number of ambulance calls per 100 patients	60 (18, 96)	9 (5, 24)
Number of hospitalizations for any reason per 100 patients	48 (20, 137)	17 (10, 70)
Number of outpatient visits, per 100 patients	123 (108, 186)	175 (134, 219)

Note: data are presented as median (25, 75 percentiles); taking into account the intersections between the groups, the assessment of the differences in burden indicators between the groups was not performed.
Abbreviation: HF — heart failure.

(53,6% from those who gave the data on the request, the adult population corresponds to 18,9% from the entire adult population of RF) (Figure 1 A, B). In the expanded encoding of HF, the median of the HF prevalence was 2,6% (IQR 1,7-3,7, range from 0,04 to 14,4%), the median of lethality — 3,2% (IQR 1,9-8,1%, range from 0,04 to 48,68%). The maximum and minimum lethality rate was noted in two regions with the minimum and maximum values of the prevalence (Figure 2 A). In accounting all available information, the correlation between the indicators of the prevalence and lethality was absent; in deletion of two extreme values in expanded encoding there was the reverse correlation between the prevalence and lethality (r=-0,67, p=0,013).

In average, the presence of I50.x code was observed in 9,4% of all cases of HF established according to the encoding data (IQR 2,4-19,3%, range from 0,5 to 34,5%). The accounting for I50.x code only corresponded to the median of HF prevalence 0,21% (IQR 0,04-0,44%, range from 0,01 to 0,72%) and lethality 11,3% (IQR 2,42-24,7%, range from 0,99% to 48,70%) (Figure 2 B). The median value of the proportion of patients with the presence of I50.x code in diagnosis in relation to the total number of patients of the expanded encoding group was higher at the inpatient stage of providing medical care than at outpatient stage — 11,8% (IQR 2,8-28,6%) vs 5,4% (IQR 1,1-8,9%).

The proportion of seeking medical care for the cohort of patients with the codes characterizing the presence of HF in relation to the total number of seeking medical care varied greatly between the regions and depending on the approach to the

disease encoding (Table 1). The greatest burden was noted on the ambulance service and the inpatient unit. With a total lower burden on healthcare system in the case of standard encoding, the number of ambulance calls and hospitalizations for any reason per 100 patients was greatly higher than in expanded encoding (Table 1).

Discussion

Using the method of structured collection of information from the subjects of the Russian Federation, the present study showed high heterogeneity of the reported data on the prevalence and mortality in HF established according to the encoding data, different frequency of use of the I50.x code according to ICD-10 and differences in the indicators of the burden on the healthcare system associated with HF. It was established that the predominant source of the information on cases of providing medical care for patients with HF is the databases of the territorial compulsory medical insurance fund of the subjects of the Russian Federation, while in at least half of the cases (in 46% of the regions that gave the data) this information is not used for accounting and operational monitoring. The obtained results indicate existing gaps and the need to develop the common principles of the accounting and encoding of cases of HF in RF that will provide assessing the burden of the disease and monitoring the effectiveness of measures at the regional and federal levels.

The previously performed population studies have demonstrated significant heterogeneity of the indicators of the prevalence and lethality in HF between countries [14]. Apart from the differences in the availability and quality of providing medical care, one of the probable reasons for the heterogeneity of the values of statistical parameters are different disease accounting systems. Data from national statistical services, databases of insurance medical organizations and medical information systems, large population studies, registries are used as the sources of information.

In the present study, despite the similar source of the information in most regions, the differences between extreme values of the parameters showing the prevalence and lethality in HF according to encoding data were more than three hundred- (range from 0,04% to 14,4%) and thousandfold (range from 0,04% to 48,68%) in the case of expanded encoding and greatly lower in the case of standard encoding (prevalence ranges from 0,01% to 0,72%, lethality ranges from 0,99% to 48,70%, respectively). High variability was previously shown for the standardized indicator of mortality rate from HF too [10] that in combination with high variability of other statistical parameters once more emphasizes the importance of the development and implementation in RF of a unified encoding system, in particular, HF. Indeed, the observed associations between the prevalence and lethality indicate the presence of contradictory approaches — the accounting for only severe cases of HF with the highest lethality rate in one regions and the overdiagnostics of HF in CVDs with more favorable prognosis in other regions. In the situation of low availability of analyzing the level of natriuretic peptides which are recommended for the diagnostics of HF with intermediate and preserved EF of the left ventricle [15], the problem of the overdiagnostics of HF can remain relevant.

It is assumed that the prevalence of HF is in average 1-3% of adult population [16], and varies between countries. According to the Heart Failure Atlas of European Society of Cardiologists (HFA ESC), the indicator of the incidence of HF in European countries vary in the range 1,99-6,55 per 1000 patient-years, and the prevalence of HF — in the range 1,2-3,9% (the corresponding information for RF is not presented in the Atlas) [12]. According to the analysis of the expanded encoding data given by the regions, the prevalence of HF in RF in average is 2,6%, with little variability of the indicator in most of the regions and 1-5% range of its value. While using the standard encoding, the prevalence of HF in RF will not exceed 1%, that together with general information about the high prevalence of CVDs in the RF and a very high level of cardiovascular risk, rather indicates an underaccounting of a significant number of HF cases. It should be emphasized that the frequency of the use of I50.x codes differed dozens of times between the regions (the range is from 0,5 to 34,5% among all potential cases of HF) including the large regions that does not allow us to interpret the obtained differences as an error of small sample size only. At the same time, for the analyzed regions, as in our earlier study in Saint-Petersburg [9], it was also noted that the presence of the I50.x code on average characterizes patients of higher risk, with frequent ambulance calls, frequent hospitalizations and high mortality.

Limitations of study. The performed study has a number of limitations. The main of them is the use of the information to analyze, given by the subjects of RF but not the data from official sources of statistical information. Nevertheless, the systematic collection of the information about the prevalence and lethality in HF is not carried out, and the annual statistical digests of Federal State Statistics Service provide the data on only main nosologies (ischemic heart disease and cardiovascular diseases) or on other heart diseases as a set of I30.x-I51.x codes. The extrapolation of data from large Russian studies (with a systematic selection error typical of them) to the entire population of the Russian Federa-

tion also has certain limitations. In addition, taking into account that all main powers for planning and implementing measures in HF, which are planned within the regional programs "Fight against cardiovascular diseases", are assigned to the subjects of RF, it is important to analyze the statistical parameters available today.

Despite the sampling to analyze the prevalence and lethality in HF corresponded to 19% of total adult population of RF, we used the data of just small part of the subject of RF, and in the situation of the insufficiency and high heterogeneity of the data, the median values of the analyzed indicators may not reflect the true average Russian value. Nevertheless, the present study is one of the first attempts to analyze and attract attention to solving the problems of the systematic collection of statistical information for patients with HF at the level of the regions and the country as a whole.

It should be emphasized that there is no a universal approach to the choosing of the codes which should be considered for assessing the burden of HF. The Global Burden of Disease Study 2017 used the list of >50 codes of cardiovascular, pulmonary, endocrine, hematological and other diseases [17]. American Hospital Registry of Heart Failure Get with the Guidelines is based on the key codes of ICD-10 (I11.0, I13.0, I13.2, I50.x), whereas National Heart Failure Audit in the UK — on 7 codes (I11.0, I25.5, I42.0, I42.9, I50.0, I50.1, I50.9); the information of the HF epidemiology is also published based on the data reported by a doctor (SwedeHF) or a patient (NHANES). Despite the fact that in our study we accounted many codes used in earlier performed studies [11], the searching the most optimal approach is required, with high sensitivity and specificity for HF in Russian population, proved in validation studies and in audit of the quality of providing medical care.

Conclusion

According to the information given by 15 regions for 2019, we noted high heterogeneity of the indicators reflecting prevalence and lethality in HF and the burden to the healthcare system, associated with HF. The medians of prevalence and lethality in HF were 2,6 and 3,2% according to expanded encoding (I09.9, I11.0, I13.0, I13.2, I25.5, I42.0, I42.5, I42.6, I42.7, I42.8, I42.9, I43.0, I43.1, I43.2, I43.8, I50.x) and 0,21 and 11,3% — according to standard (the accounting for only I50.x code) encoding of HF. The presence of I50.x code in diagnosis mainly characterizes the cohort of patients with a large number of seeking emergency and inpatient medical care, less number of outpatient visits and greater lethality. It is necessary to develop a unified approach to encoding cases of HF and accounting at the country level in order to obtain objective statistical data and use them for management decisions. The improvement of regional medical information systems and the development of VIMIS CVD with an increase in the number of available data, including the clinical and demographic characteristics of patients, and further analysis of indicators at the country level, including those standardized by gender and age, will further provide a detailed assessment of the burden of HF in the RF and contribute in determination of the necessary steps to reduce it.

Relationships and Activities: none.

References

1. 2020 Clinical practice guidelines for Chronic heart failure. Russian Journal of Cardiology. 2020;25(11):4083. (In Russ.) doi:10.15829/1560-4071-2020-4083.
2. Arutyunov AG, Dragunov DO, Arutyunov GP, et al. First Open Study of Syndrome of Acute Decompensation of Heart Failure and Concomitant Diseases in Russian Federation: Independent Registry ORAKUL on behalf of the study group. Kardiologiia. 2015;55(5):12-21. (In Russ.)
3. Villevalde SV, Soloveva AE, Zvartau NE, et al. Principles of organization of medical care for patients with heart failure in the system of cardiovascular risk management: focus on continuity of care and patient routing. Practical materials. Russian Journal of Cardiology. 2021;26(S3):4558. (In Russ.) doi:10.15829/1560-4071-2021-4558.
4. Glezer MG, Chernyavskaya TK. Modern approaches to the organization of care for patients with heart failure. Kardiologiia. 2020;60(8):106-14. (In Russ.) doi:10.18087/cardio.2020.8.n866.
5. Vinogradova NG. City Center for the Treatment of Chronic Heart Failure: the organization of work and the effectiveness of treatment of patients with chronic heart failure. Kardiologiia. 2019;59(2S):31-9. (In Russ.) doi:10.18087/cardio.2621.
6. Shlyakhto EV, Zvartau NE, Villevalde SV, et al. Implemented models and elements for heart failure care in the regions of the Russian Federation: prospects for transformation into regional cardiovascular risk management systems. Russian Journal of Cardiology. 2020;25(4):3792. (In Russ.) doi:10.15829/1560-4071-2020-4-3792.
7. Tromp J, Ouwerkerk W, van Veldhuisen DJ, et al. A Systematic Review and Network Meta-Analysis of Pharmacological Treatment of Heart Failure With Reduced Ejection Fraction [published correction appears in JACC Heart Fail. 2022;10(4):295-6]. JACC Heart Fail. 2022;10(2):73-84. doi:10.1016/j.jchf.2021.09.004.
8. Takeda A, Martin N, Taylor RS, Taylor SJC. Disease management interventions for heart failure. Cochrane Database of Systematic Reviews. 2019;(1). Art. No.: CD002752. doi:10.1002/14651858.CD002752.pub4.
9. Soloveva AE, Endubaeva GV, Avdonina NG, et al. ICD-10 code-based definition of heart failure in Saint Petersburg electronic health records: prevalence, health care utilization and outcomes. Russian Journal of Cardiology. 2021;26(S3):4621. (In Russ.) doi:10.15829/1560-4071-2021-4621.
10. Boytsov SA, Drapkina OM, Zayratyants OV, et al. Ways to solve the problem of heart failure statistics in clinical practice. Kardiologiia. 2020;60(10):13-9. (In Russ.) doi:10.18087/cardio.2020.10.n1039.
11. McCormick N, Lacaille D, Bhole V, Avina-Zubieta JA. Validity of heart failure diagnoses in administrative databases: a systematic review and meta-analysis. PLoS One. 2014;9(8):e104519. doi:10.1371/journal.pone.0104519.

12. Seferović PM, Vardas P, Jankowska EA, et al.; National Heart Failure Societies of the ESC member countries (see Appendix). The Heart Failure Association Atlas: Heart Failure Epidemiology and Management Statistics 2019. Eur J Heart Fail. 2021. doi:10.1002/ejhf.2143.
13. Belenkov YuN, Mareev VYu, Ageev FT, et al. The true prevalence of CHF in the European part of the Russian Federation (hospital stage). Zhurnal serdechnaya nedostatochnost. 2011;12(2):63-8. (In Russ.)
14. Groenewegen A, Rutten FH, Mosterd A, Hoes AW. Epidemiology of heart failure. Eur J Heart Fail. 2020;22(8):1342-56. doi:10.1002/ejhf.1858.
15. Lopatin YuM, Nedogoda SV, Arkhipov MV, et al. Pharmacoepidemiological analysis of routine management of heart failure patients in the Russian Federation. Part I. Russian Journal of Cardiology. 2021;26(4):4368. (In Russ.) doi:10.15829/1560-4071-2021-4368.
16. McDonagh TA, Metra M, Adamo M, et al. 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure [published correction appears in Eur Heart J. 2021]. Eur Heart J. 2021;42(36):3599-26. doi:10.1093/eurheartj/ehab368.
17. Bragazzi NL, Zhong W, Shu J, et al. Burden of heart failure and underlying causes in 195 countries and territories from 1990 to 2017. Eur J Prev Cardiol. 2021;28(15):1682-90. doi:10.1093/eurjpc/zwaa147.