

DOI: 10.21802/artm.2021.3.19.88  
UDC 616.12-008.46:616.61-008.61]-036.1-08-053.9

## MEDICATION ADHERENCE AND DECREASED KIDNEY FUNCTION AS PREDICTORS OF HOSPITALIZATION FOR CHRONIC HEART FAILURE IN ELDERLY PATIENTS

O.O. Khaniukov, O.V. Smolianova

*Dnipro State Medical University, Department of Internal Medicine 3, Dnipro, Ukraine,  
ORCID ID: 0000-0003-4146-0110, e-mail: alex1313@dsma.dp.ua;  
ORCID ID: 0000-0002-8654-381X, e-mail: smolyanova.ukr@gmail.com*

**Abstract.** Hospitalizations due to worsening of the clinical course of ambulatory care sensitive conditions (ACSC) are the significant and growing burden on health systems. Chronic heart failure (CHF) is one of the five leaders among chronic ACSC both in the frequency of hospitalizations and in their cost. Therefore, it is important to find predictors of the clinical course worsening which are easy to use in ambulatory settings.

**The aim of the research:** to assess the effect of medication adherence and decreased renal function on the probability of hospitalization for CHF in the elderly during 6 months.

**Materials and methods.** The prospective research included 111 ambulatory elderly patients aged from 60 to 74 years with CHF, stage II, arterial hypertension, stage II and chronic kidney disease, stage II-IIIa. During the first ambulatory visit a general clinical examination and ambulatory card analysis were performed. Creatinine level was checked with calculation of the glomerular filtration rate according to the formula of the Chronic Kidney Disease Epidemiology Collaboration (GFR EPI) to assess renal function. In addition, a 6-minute walk test (6MWT) was performed and a quality of life assessment was conducted according to Minnesota Living with Heart Failure Questionnaire. Adherence assessment on a Morisky Green Medication Adherence Scale as well as a collection of the information about hospitalization during the previous 6 months was done during the last visit. The variable "interaction" between decreased renal function and poor medication adherence was introduced separately into the logistic analysis. A logistic regression analysis was used to assess the influence of factors on the probability of hospitalization for CHF.

**Results.** During the observation 21 patients were hospitalized for CHF (21/93, 23%). The analysis of the distribution of adherence level and GFR EPI  $\leq 59,9$  mL/min/1,73 m<sup>2</sup> between groups of hospitalized and non-hospitalized patients revealed a predominance of non-adherent patients, as well as those with decreased renal function, in the group of hospitalized ones. Clinical characteristics and laboratory parameters, by which the differences were found between hospitalized and non-hospitalized patients, as well as categorical variables received by ROC-analysis - quality of life, GFR EPI<sub>cat</sub>, systolic blood pressure, 6MWT<sub>cat</sub>, and variable "interaction", were included in the univariate logistic analysis. According to univariate logistic analysis, the hospitalization probability increased with GFR EPI  $\leq 59,9$  mL/min/1,73 m<sup>2</sup> (OR-6,73, CI 2,34-19,35) and decreased in the presence of medication adherence (OR-0,08, CI 0,02-0,37). In multivariate analysis (adjustment for lung crackles and functional class according to NYHA) or were 4,95 (CI 1,18-20,78) for GFR EPI  $\leq 59,9$  mL/min/1,73 m<sup>2</sup> and 0,11 (CI 0,02-0,81) for medication adherence. During assessing the "interaction" variable it was found that in non-adherent patients with GFR EPI  $\leq 59,9$  mL/min/1,73 m<sup>2</sup> the chance of inpatient treatment for CHF significantly increased by 6.82 times on average, with a maximum increase by 20 times.

**Conclusions.** Medication adherence and decreased renal function in our research were shown to be significant predictors of hospitalization for CHF, which are simple to measure and assess and can be used in an outpatient setting. By increasing adherence level, especially in elderly patients with impaired renal function, it is possible to reduce the chance of inpatient treatment caused by CHF by 9.1 times.

**Keywords:** chronic heart failure, medication adherence, decreased renal function, hospitalisation, the elderly

**Introduction.** Hospitalizations due to worsening of the clinical course of ambulatory care sensitive conditions (ACSC) are the significant and growing burden on health systems [1]. Chronic heart failure (CHF) is one of the five leaders among chronic ACSC both in the frequency of hospitalizations and in their cost [2]. According to the MEDICARE database, the average cost of one inpatient treatment for a patient with CHF is 14,631 dollars [2], and this value could potentially increase even more, given the high frequency of re-hospitalizations [2], [3], [4].

If we integrate the above with the fact that the prevalence of CHF is continuously growing with the concomitant increase in the hospitalization numbers [3],

the cost of lifelong patients treatment can cause a significant strain on the health care system [4]. Costs almost double in the simultaneous presence of CHF and chronic kidney disease (CKD). The combination of these diseases in the elderly in 2017 led to expenses of \$ 29 million, accounting for about 50% of the total cost of CHF treatment in this category of patients in the United States [5].

The presence of CKD accompanied neurohumoral changes that could lead to homeostasis disturbances with sodium and fluid retention, resulting in decompensation leading to hospitalization [6], [7]. The latter, in turn, is a trigger for further renal function decline [7], [8]. Decreased renal function and hospitalization for CHF are separately associated with a worse pa-

tient's prognosis, and it becomes even worse in case of these factors combination [7]. Moreover, the risk of events in a patient with CHF is high both during hospitalization and after discharge from the hospital [9].

An equally important factor influencing the hospitalizations level is medication adherence, especially in the long run [10], [11]. Maintenance of a high level of adherence in patients who need lifelong treatment is a lever that can be used to reduce the hospitalizations frequency [10].

**Rationale for the research.** Based on the aforementioned, a decrease in renal function and medication adherence are factors associated with the probability of hospitalization. However, it remains unknown how much they together affect the hospitalization risk. This question is relevant because, given the irreversibility of the glomerular filtration rate (GFR) decline in CKD, the adherence level is a predictor that can and should be influenced.

**The aim of the research:** to assess the effect of medication adherence and decreased renal function on the probability of hospitalization for CHF in the elderly during 6 months.

**Materials and methods.** The prospective research included 111 ambulatory elderly patients with CHF. Inclusion criteria were age from 60 to 74 years, the presence of CHF stage II, arterial hypertension (AH) stage II and CKD stage II-IIIa. Exclusion criteria were chronic glomerulonephritis, chronic pyelonephritis, urolithiasis, diabetes mellitus, decompensated liver cirrhosis, cancer. Only observations with a complete data set (93 patients) were used for analysis.

The research consisted of two stages: during the first outpatient visit and 6 months after it. During the first ambulatory visit a general clinical examination and ambulatory card analysis were performed. Creatinine level was checked with subsequent calculation of the glomerular filtration rate according to the formula of the Chronic Kidney Disease Epidemiology Collaboration (GFR EPI) to assess renal function. In addition, a 6-minute walk test (6MWT) was performed and a quality of life assessment (QoL) was conducted according to Minnesota Living with Heart Failure Questionnaire (MLHFQ). Assessment of adherence on a Morisky Green Medication Adherence Scale as well as information collection about hospitalization during the previous 6 months were done during the last visit.

Most of the data had a non-normal distribution, so the continuous variables are given as the median (Me) with the first and third quartiles [25; 75]. Categorical data are presented as the number of patients (n) with their percentage in the research group (%). To assess the significance of differences between groups of hospitalized and non-hospitalized patients, the Mann-Whitney U test for quantitative variables and Pearson's  $\chi^2$  test (including, with Yates's correction) or Fisher's exact test for nominal ones were used. To assess the influence of factors on the probability of hospitalization for CHF a logistic regression analysis was used. Variables that showed to be statistically significant in the univariate logistic analysis were used in multiple logistic models [12]. For all variables in the multiple regression equation, the presence of multicollinearity and outliers were checked, and the

number of observations per 1 predictor exceeded 10. To recode continuous variables into categorical ones, a ROC analysis was held to determine the cut-off point using Youden's index (J) with related AUC and the sensitivity (Se) and specificity (Sp) of the found point. The AUC is given together with 95% CI. Medication adherence and functional class (FC) according to NYHA was coded using a dummy variable, where the value of "1" corresponds to 3 points for adherence and II FC for NYHA. In addition, the variable "interaction" was introduced separately into the logistic analysis, and the value of "1" was given in the case if the patient had  $GFR\ EPI \leq 59.9$  ml/min/1.73m<sup>2</sup> together with poor medication adherence on the Morisky Green Scale. The statistical significance of the regression coefficients was checked using Wald's statistics. The contribution of each predictor included in the multiple logistic equation to the probability of hospitalization was assessed using the value of odds ratio (OR), which is given with the corresponding 95% CI. All tests were two-tailed and the results considered significant at  $p < 0.05$ . Statistical analyses were performed by using STATISTICA software package (StatSoft Inc., ver.6.1, serial number AGAR909E415822FA). ROC analysis and construction of ROC curves were performed in the MedCalc software package (www.medcalc.org, trial version 20.009).

**Results.** During the observation 21 patients were hospitalized for CHF (21/93, 23%). Among hospitalized patients, women predominated (29 versus 40%), but the difference was not statistically significant. The age of patients who need inpatient treatment did not differ from those who did not need it ( $p > 0.05$ ). A statistically significant difference ( $p < 0.05$ ) in the AH duration (10 [8; 11] versus 8 [7; 10]) and the level of systolic blood pressure (SBP), mm Hg (149 [143; 152] versus 142 [137; 148]) was found between hospitalized and non-hospitalized, respectively. When assessing renal function, the groups differed significantly in the level of creatinine,  $\mu\text{mol} / \text{l}$  (88 [86; 95] versus 83 [79; 89]) and GFR EPI, ml/min/1.73m<sup>2</sup> (59.8 [56; 70.2] versus 69.9 [64.2; 79.7]) for hospitalized and non-hospitalized, respectively. At clinical assessment in hospitalized patients were more likely to detect lung crackles (67% (14/21) versus 14% (10/72)), higher NYHA FC (for I FC - 0% versus 44% (32/72), for II FC - 95% (20/21) versus 53% (38/72)), and during 6MWT they passed on average a smaller distance in meters (287 [282; 311] versus 364 [309; 404]). At the survey, hospitalized patients had a higher QoL score in points (higher score - worse QoL on MLHFQ) - 49 [44; 57] versus 40 [30; 47], and worse medication adherence level (1 and 2 points were chosen by 91% (19/21) versus 43% (31/72)).

Continuous variables QoL, GFR EPI, SBP, and 6MWT were recoded into dichotomous ( $QoL_{cat}$ ,  $GFR\ EPI_{cat}$ ,  $SBP_{cat}$ ,  $6MWT_{cat}$ ) using ROC-analysis, and a value of "1" was given to the category, which is associated with an increased hospitalization probability. The cut-off points were as follows:  $QoL > 41$  score (J-0,44, AUC-0,76 (0,66-0,85), Se-85,71%, Sp-58,33%,  $p < 0,01$ );  $GFR\ EPI \leq 59,9$  mL/min/1,73 m<sup>2</sup> (J-0,43, AUC-0,7 (0,6-0,8), Se-61,9%, Sp-80,56%,  $p < 0,01$ );  $SBP > 142$  mmHg (J-0,30, AUC-0,71 (0,61-0,8), Se-76,19%, Sp-54,17%,

p<0,01); 6MWT ≤311 m (J-0,53, AUC-0,78 (0,68-0,86), Se-80,95%, Sp-72,22%, p<0,01).

Clinical characteristics and laboratory parameters, by which the differences were found between hospitalized and non-hospitalized patients, as well as categorical variables - QoL<sub>cat</sub>, GFR EPI<sub>cat</sub>, SBP<sub>cat</sub>, 6MWT<sub>cat</sub>, and

variable "interaction", were included in the univariate logistic analysis.

Data on the prognostic capacity of variables obtained in the univariate logistic analysis, together with the assessment of the equations' quality and their predictive value are presented in table 1.

Table 1

Clinical and laboratory predictors of hospitalization (univariate analysis)

Predictor	Regression coefficient (standard error)	Wald's statistics (p)	χ <sup>2</sup> (p)	OR (95% CI)	AUC (95% CI)
SBP, mm Hg	0,11 (0,04)	7,9 (<0,01)	8,88 (<0,01)	1,12 (1,04-1,21)	0,71 (0,61-0,8)
SBP <sub>cat</sub>	1,33 (0,56)	5,56 (0,02)	6,29 (0,01)	3,78(1,25-11,43)	0,65 (0,55-0,75)
AH duration, years	0,24 (0,11)	4,94 (0,026)	5,1 (0,025)	1,27 (1,02-1,6)	0,67 (0,56-0,76)
QoL, score	0,12 (0,03)	11,8 (<0,01)	15,2 (<0,01)	1,1 (1,05-1,18)	0,76 (0,66-0,85)
QoL <sub>cat</sub>	2,13 (0,67)	10,15 (<0,01)	13,8 (<0,01)	8,4 (2,27-31,1)	0,72 (0,62-0,81)
Creatinine, μmol/L	0,08 (0,03)	6,3 (0,01)	6,9 (<0,01)	1,08 (1,02-1,15)	0,67 (0,57-0,76)
GFR EPI, mL/min/1,73 m <sup>2</sup>	-0,07 (0,03)	6,6 (0,01)	7,8 (<0,01)	0,94 (0,89-0,99)	0,7 (0,6-0,8)
6MWT, m	-0,02 (<0,01)	10,23 (<0,01)	13,4 (<0,01)	0,98 (0,97-0,99)	0,78 (0,68-0,86)
6MWT <sub>cat</sub>	2,4(0,6)	15,27(<0,01)	19,5(<0,01)	11,1 (3,3-36,88)	0,77 (0,67-0,85)
Crackles over the lungs	2,52 (0,58)	19,18 (<0,01)	21,45 (<0,01)	12,4 (4,02-38,26)	0,76 (0,67-,85)
NYHA FC	2,83 (1,05)	7,24 (<0,01)	14,77 (<0,01)	16,9 (2,15-132,94)	0,71 (0,6-0,8)
Medication adherence	-2,53 (0,78)	10,51 (<0,01)	16,77 (<0,01)	0,08 (0,02-0,37)	0,74 (0,64-0,82)
GFR EPI <sub>cat</sub>	1,91 (0,54)	12,51 (<0,01)	13,21 (<0,01)	6,73 (2,34-19,35)	0,72 (0,61-0,80)
Interaction	1,92 (0,56)	12,01 (<0,01)	12,27 (<0,01)	6,82 (2,3-20,21)	0,69 (0,59-0,78)

The analysis of the distribution of adherence and GFR EPI<sub>cat</sub> between groups of hospitalized and non-hospitalized patients revealed a predominance of non-adherent patients, as well as those with decreased renal function, in the group of hospitalized ones (Fig. 1).

Given that both indicators may have an impact on the level of hospitalization, but had non-equal distri-

bution between the groups, it was checked whether the variables shown in table 1 retain their significant impact after adjustment for the adherence and GFR EPI<sub>cat</sub> (Table 2).

Next in our research, we measured the effect of medication adherence and GFR EPI<sub>cat</sub> on the probability of hospitalization caused by CHF (Table 3).

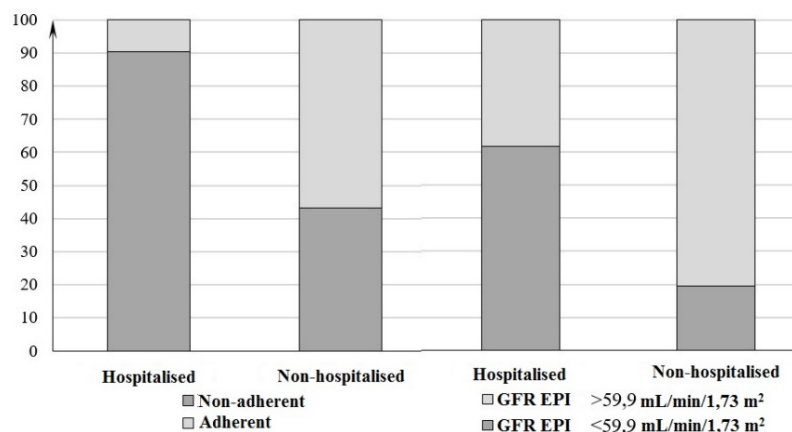


Fig. 1. The structure of cohorts of hospitalized and non-hospitalized patients by level of adherence and GFR EPI<sub>cat</sub>.

Table 2

Clinical and laboratory predictors of hospitalization (multivariable analysis)

Predictor	OR <sup>1</sup> (95% CI)	p*	OR <sup>2</sup> (95% CI)	p*	OR <sup>3</sup> (95% CI)	p*
SBP, mm Hg	1,05 (0,96-1,2)	0,01	1,07 (1,36-14,44)	0,16	1 (0,9-1,1)	0,98
SBP <sub>cat</sub>	1,36 (0,37-4,94)	0,64	1,82 (0,51-6,5)	0,36	0,63 (0,14-2,8)	0,55
AH duration, years	1,21 (0,96-1,51)	<0,01	1,04 (0,8-1,35)	0,76	1,03 (0,79-1,36)	0,82
QoL, score	1,08 (1,01-1,16)	0,035	1,08 (1,02-1,16)	0,016	1,05 (0,98-1,13)	0,19
QoL <sub>cat</sub>	3,36 (0,76-14,78)	0,11	4,84 (1,18-19,97)	0,029	1,72 (0,33-9,02)	0,52
6MWT, m	0,99 (0,98-0,999)	<0,029	0,99 (0,98-1,0)	0,056	0,99 (0,98-1,01)	0,27
6MWT <sub>cat</sub>	6,81 (1,9-24,13)	<0,01	6,89 (1,81-26,24)	<0,01	4,62 (1,16-18,39)	0,03
Lung crackles	8,07 (2,45-26,54)	<0,01	11,65 (3,41-39,68)	<0,01	9,52 (2,6-34,85)	<0,01
NYHA FC	12,32 (1,5-101)	0,019	11,02 (1,35-90,1)	0,025	9,1 (1,1-77,38)	0,043

Notes:\* - the significance level of Wald's statistics for the corresponding coefficient in the logistic equation. OR<sup>1</sup> – adjusted for adherence. OR<sup>2</sup> – adjusted for GFR EPI<sub>cat</sub>. OR<sup>3</sup> - adjusted for both adherence and GFR EPI<sub>cat</sub>.

Table 3

Medication adherence and GFR EPI<sub>cat</sub> as hospitalization predictors (multiple logistic analysis)

Predictor	Regression coefficient	Standard error	Wald's statistics	p for Wald's statistics	OR (95% CI)
Medication adherence*	-2,18	0,99	4,82	0,028	0,11 (0,02-0,81)
GFR EPI <sub>cat</sub> *	1,6	0,72	4,9	0,027	4,95 (1,18-20,78)

Notes:\* - Factors are adjusted for the presence of crackles over the lungs and NYHA FC.

**Discussion.** The analysis of the obtained results revealed that the SBP and duration of AH were significant predictors in the univariate analysis, but after ensuring a uniform distribution of adherence and GFR EPI<sub>cat</sub> they lost their significant effect on the inpatient treatment probability in our research. The QoL score as a continuous variable remained a significant predictor of hospitalizations only when controlling either adherence or GFR EPI<sub>cat</sub>, but lost its effect when simultaneously controlling both of these covariates. QoL<sub>cat</sub> had an effect on hospitalization only when was introduced into the logistic equation along with the GFR EPI<sub>cat</sub>, but the introduction into the equation with the adherence, as well as with adherence and GFR EPI<sub>cat</sub> simultaneously, excluded this predictor from the range of significant variables. After controlling the adherence by multivariate regression, both 6MWT variables (the continuous and the obtained using the cut-off point) continued to affect significantly the hospitalization probability. However, after GFR EPI<sub>cat</sub> control, as well as simultaneous control of GFR EPI<sub>cat</sub> and adherence, only 6MWT<sub>cat</sub> remained a significant predictor of inpatient treatment in the next 6 months. Of

the variables listed in Table 2, only NYHA FC and the presence of lung crackles were significant independent predictors of hospitalization in all three equations, i.e. their effect remained statistically significant even after control of adherence and GFR EPI<sub>cat</sub>.

GFR EPI as a continuous variable has not been shown to be a statistically significant hospitalization predictor according to the results of both simple and multiple analyses (correction for adherence). Based on the data given in table 3, the GFR EPI ≤ 59.9 ml/min/1.73m<sup>2</sup> (as a binary variable) has a significant impact on the chance of hospitalization caused by CHF. The chance of inpatient treatment for the patient who has GFR EPI ≤ 59.9 ml/min/1.73m<sup>2</sup> increases by 573% in the univariate logistic analysis, and by 395% when controlling other covariates by multiple logistic analysis (compared with patients with GFR EPI ≥ 59.9 ml/min/1,73m<sup>2</sup>). That is, a decline of kidney function leads to an increased probability of the patient being hospitalized, which coincides with the data Damman et al. [6] i Mullens et al. [7].

During assessing the "interaction" variable it was found that in non-adherent patients with GFR



EPI $\leq$ 59,9 ml/min/1,73m<sup>2</sup> the chance of inpatient treatment for CHF significantly increased by 6.82 times on average, with a maximum increase by 20 times (table 1).

In a univariate analysis, the hospitalization chance in adherent patients was only 8% from that in non-adherent ones. When variables GFR EPI<sub>cat</sub>, NYHA FC, presence of lung crackles were controlled by multiple logistic regression, the chance of hospitalization of adherent to treatment patients was even less being only 2.8% of the chance of non-adherent ones. According to the obtained data, it can be concluded that the adherence indicator had protective properties and was inversely related to the indicator of hospitalization chance: an increase in adherence led to a decrease in the hospitalization probability. A similar effect of medication adherence on the level of hospitalization was shown in a study by Hood et al. [11], who found that an increase in adherence leads to a decrease in the frequency of hospitalizations.

The importance of the obtained data is explained as follows. If a patient already has CKD, GFR irreversibly decreases with time and the doctor can usually only slow down the rate of this decline. In old age decline in GFR caused by age-related changes [13], further accelerated due to pathological changes caused by diseases (AH, CKD and CHF) [7], [14], [15], especially in case of poor control of their compensation. The latter is highly dependent on evidence-based therapy, which is recommended by guidelines. Therefore, understanding that GFR EPI $\leq$ 59.9 ml/min/1.73m<sup>2</sup> is an indicator that we can hardly influence, attention should be paid to the level of patient medication adherence. This is especially true in a patient with already existing CKD stage 3a because by increasing the level of medication adherence, we simultaneously reduce the patient's chance of being hospitalized for CHF by 9.1 times.

**Conclusions.** Medication adherence and decreased renal function in our research were shown to be significant predictors of hospitalization for CHF, which are simple to measure and assess and can be used in an outpatient setting. By increasing adherence level, especially in elderly patients with impaired renal function, it is possible to reduce the chance of inpatient treatment caused by CHF by 9.1 times.

**Perspectives for further research.** Assessing the impact of medication adherence and renal function on the long-term prognosis of hospitalizations involving more patients.

#### References:

- Leventer-Roberts M, Cohen-Stavi C, Hoshen M, Gofer I, Sherf M, Balicer R. Analyzing admission rates for multiple ambulatory care-sensitive conditions. *Am J Manag Care.* 2020; 26(5):155-61. DOI: <https://doi.org/10.37765/ajmc.2020.43158>
- Kilgore M, Patel HK, Kielhorn A, Maya JF, Sharma P. Economic burden of hospitalizations of Medicare beneficiaries with heart failure. *Risk Manag Healthc Policy.* 2017; May, 10:63-70. DOI: <https://doi.org/10.2147/RMHP.S130341>
- Ponikowski P, Voors AA, Anker SD, Bueno H, Cleland JGF, Coats AJS, et al. 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; Jul, 37(27):2129-200. DOI: <https://doi.org/10.1093/eurheartj/ehw128>
- Lesyuk W, Kriza C, Kolominsky-Rabas P. Cost-of-illness studies in heart failure: a systematic review 2004-2016. *BMC Cardiovasc Disord.* 2018; May, 18(1):74. DOI: <https://doi.org/10.1186/s12872-018-0815-3>
- Saran R, Robinson B, Abbott KC, Agodoa LY, Bragg-Gresham J, Balkrishnan R, et al. US Renal Data System 2018 annual data report: epidemiology of kidney disease in the United States. *Am J Kidney Dis.* 2019; Mar, 73(3 Suppl 1):7-8. DOI: <https://doi.org/10.1053/j.ajkd.2019.01.001>
- Damman K, Valente MAE, Voors AA, O'Connor CM, van Veldhuisen DJ, Hillege HL. Renal impairment, worsening renal function, and outcome in patients with heart failure: an updated meta-analysis. *Eur Heart J.* 2014; Feb, 35(7):455-69. DOI: <https://doi.org/10.1093/eurheartj/ehz386>
- Mullens W, Damman K, Testani JM, Martens P, Mueller C, Lassus J, et al. Evaluation of kidney function throughout the heart failure trajectory – a position statement from the Heart Failure Association of the European Society of Cardiology. *Eur J Heart Fail.* 2020; Apr, 2(4):584-603. DOI: <https://doi.org/10.1002/ejhf.1697>
- Damman K, Masson S, Lucci D, Gorini M, Urso R, Maggioni AP, et al. Progression of renal impairment and chronic kidney disease in chronic heart failure: an analysis from GISSI-HF. *J Card Fail.* 2017; Jan, 23(1):2-9. DOI: <https://doi.org/10.1016/j.cardfail.2016.09.006>
- Taylor CJ, Ordóñez-Mena JM, Roalfe AK, Lay-Flurrie S, Jones NR, Marshall T, et al. Trends in survival after a diagnosis of heart failure in the United Kingdom 2000-2017: population based cohort study. *BMJ.* 2019; Feb, 364:l223. DOI: <https://doi.org/10.1136/bmj.l223>
- Sweeney M, Cole GD, Pabari P, Hadjiphilippou S, Tayal U, Mayet J, et al. Urinary drug metabolite testing in chronic heart failure patients indicates high levels of adherence with life prolonging therapies. *ESC Heart Fail.* 2021; Jun, 8(3):2334-7. DOI: <https://doi.org/10.1002/ehf2.13284>
- Hood SR, Giazoni AJ, Seamon G, Lane KA, Wang J, Eckert GJ, et al. Association between medication adherence and the outcomes of heart failure. *Pharmacotherapy.* 2018; May, 38(5):539-45. DOI: <https://doi.org/10.1002/phar.2107>
- Chowdhury MZI, Turin TC. Variable selection strategies and its importance in clinical prediction modeling. *Fam Med Com Health.* 2020; Feb, 8(1):e000262. DOI: <https://doi.org/10.1136/fmch-2019-000262>
- Denic A, Glassock RJ, Rule AD. Structural and functional changes with the aging kidney. *Adv Chronic Kidney Dis.* 2016; Jan, 23(1):19-28. DOI: <https://doi.org/10.1053/j.ackd.2015.08.004>
- Garofalo C, Borrelli S, Pacilio M, Minutolo R, Chiodini P, De Nicola L, et al. Hypertension and prehypertension and prediction of development of de-

creased estimated GFR in the general population: a meta-analysis of cohort studies. *Am J Kidney Dis.* 2016; Jan, 67(1):89-97. DOI: <https://doi.org/10.1053/j.ajkd.2015.08.027>

15. George LK, Koshy SK, Molnar MZ, Thomas F, Lu JL, Kalantar-Zadeh K, et al. Heart failure increases the risk of adverse renal outcomes in patients with normal kidney function. *Circ Heart Fail.* 2017; Aug, 10(8):e003825. DOI: <https://doi.org/10.1161/CIRCHEARTFAILURE.116.003825>

УДК 616.12-008.46:616.61-008.61]-036.1-08-053.9  
**ПРИВЕРЖЕННОСТЬ К ЛЕЧЕНИЮ И СНИЖЕНИЕ ФУНКЦИИ ПОЧЕК КАК ПРЕДИКТОРЫ ГОСПИТАЛИЗАЦИИ ПО ПОВОДУ ХРОНИЧЕСКОЙ СЕРДЕЧНОЙ НЕДОСТАТОЧНОСТИ У БОЛЬНЫХ ПОЖИЛОГО ВОЗРАСТА**

А.А. Ханюков, А.В. Смольянова

*Дніпровський державний медичний університет, кафедра внутрішньої медицини 3, г. Дніпро, Україна,  
ORCID ID: 0000-0003-4146-0110,  
e-mail: alex1313@dsma.dp.ua;  
ORCID ID: 0000-0002-8654-381X,  
e-mail: smolyanova.ukr@gmail.com*

**Резюме.** Цель. Оценить влияние приверженности к лечению и снижения функции почек на вероятность госпитализации по поводу хронической сердечной недостаточности (ХСН) в течение 6 месяцев у больных пожилого возраста.

**Методы.** В исследование были включены 111 больных в возрасте от 60 до 74 лет с ХСН на фоне артериальной гипертензии и хронического заболевания почек. Для оценки функции почек определяли уровень креатинина и рассчитывали скорость клубочковой фильтрации (СКФ EPI). Также выполнялся тест с 6-минутной ходьбой (Т6Х), оценивалось качество жизни (КЖ) и приверженность к лечению.

**Результаты.** За время наблюдения 21 пациент был госпитализирован. Показатели, по которым были выявлены различия между госпитализированными и не госпитализированными пациентами, а также категориальные переменные КЖ, СКФ EPI, систолического артериального давления, Т6Х, и переменная «взаимодействие» были включены в унивариантный логистический анализ. По данным анализа, вероятность госпитализации увеличивалась при СКФ EPI  $\leq 59,9$  мл/мин/1,73 м<sup>2</sup> (ОШ-6,73, ДИ 2,34-19,35) и уменьшалась при наличии приверженности к лечению (ОШ-0,08, ДИ 0,02-0,37). При множественном анализе (коррекция на наличие хрипов в легких и функциональный класс по NYHA) ОШ составило 4,95 (ДИ 1,18-20,78) для СКФ EPI  $\leq 59,9$  мл/мин/1,73 м<sup>2</sup> та 0,11 (ДИ 0,02-0,81) для приверженности.

**Выводы.** Приверженность к лечению и сниженная функция почек оказались достоверными предикторами госпитализации по поводу ХСН, которые являются простыми для измерения и оценки и

могут быть использованы в амбулаторных условиях. Увеличивая показатель приверженности, особенно у пациентов с нарушением функции почек, можно добиться снижения шанса стационарного лечения у больного пожилого возраста в 9,1 раза.

**Ключевые слова:** хроническая сердечная недостаточность, приверженность к лечению, снижение функции почек, госпитализация, пожилой возраст.

УДК 616.12-008.46:616.61-008.61]-036.1-08-053.9  
**ПРИХИЛЬНІСТЬ ДО ЛІКУВАННЯ ТА ЗНИЖЕННЯ ФУНКЦІЇ НИРОК ЯК ПРЕДИКТОРИ ГОСПІТАЛІЗАЦІЇ З ПРИВОДУ ХРОНІЧНОЇ СЕРЦЕВОЇ НЕДОСТАТНОСТІ У ХВОРИХ ПОХИЛОГО ВІКУ**

О.О. Ханюков, О.В. Смольянова

*Дніпровський державний медичний університет, кафедра внутрішньої медицини 3, м. Дніпро, Україна,  
ORCID ID: 0000-0003-4146-0110,  
e-mail: alex1313@dsma.dp.ua;  
ORCID ID: 0000-0002-8654-381X,  
e-mail: smolyanova.ukr@gmail.com*

**Резюме.** Мета. Оцінити вплив прихильності до лікування та зниження функції нирок на вірогідність госпіталізації з приводу хронічної серцевої недостатності (ХСН) протягом 6 місяців у хворих похилого віку.

**Методи.** У проспективне дослідження було включено 111 хворих віком від 60 до 74 років з ХСН на фоні артеріальної гіпертензії та хронічного захворювання нирок. Для оцінки функції нирок визначали рівень креатиніну та розраховували швидкість клубочкової фільтрації (ШКФ EPI). Також виконувався тест з 6-хвилинною ходьбою (Т6Х), оцінювалася якість життя (ЯЖ) і прихильність до лікування.

**Результати.** За час спостереження 21 пацієнт був госпіталізований з приводу ХСН (21/93, 23%). Клінічні та лабораторні показники, за якими було виявлено відмінності між госпіталізованими і негоспіталізованими пацієнтами, а також категорійні змінні ЯЖ, ШКФ EPI, систолического артеріального тиску, Т6Х, та змінну «взаємодія» було включено в уніваріантний логістичний аналіз. За даними останнього, вірогідність госпіталізації збільшувалася при ШКФ EPI  $\leq 59,9$  мл/хв/1,73 м<sup>2</sup> (ВШ-6,73, ДІ 2,34-19,35) та зменшувалася при наявності прихильності до лікування (ВШ-0,08, ДІ 0,02-0,37). Для множинного аналізу (корекція на наявність хрипів у легенях та функціональний клас за NYHA) ВШ становило 4,95 (ДІ 1,18-20,78) для ШКФ EPI  $\leq 59,9$  мл/хв/1,73 м<sup>2</sup> і 0,11 (ДІ 0,02-0,81) для прихильності.

**Висновки.** Прихильність до лікування та знижена функція нирок виявилися достовірними предикторами госпіталізації з приводу ХСН, які є простими для вимірювання та оцінки і можуть бути використані в амбулаторних умовах. Збільшуючи показник прихильності, особливо у пацієнтів зі зни-

женою функцією нирок, можна досягти зниження шансу стаціонарного лікування у хворого похилого віку у 9,1 рази.

**Ключові слова:** хронічна серцева недостатність, прихильність до лікування, зниження функції нирок, госпіталізація, похилий вік.

Стаття надійшла в редакцію 06.09.2021 р.