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Cost-related non-adherence in US adults with heart failure: a repeated cross-sectional analysis of the medical expenditure panel survey, 2012 to 2021

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ABSTRACT

Objectives To investigate the prevalence and potential determinants of cost-related non-adherence (CRNA) in US adults with heart failure (HF).

Design A serial cross-sectional analysis using nationally representative data from 2012 to 2021 of the US Medical Expenditure Panel Survey.

Setting Population-based.

Participants Adult participants with HF diagnosis.

Outcome measures Self-report of never getting or delaying getting prescription medicine because of costs.

Results We included 1753 patients with HF (mean age 69.36 [95% CI, 68.23 to 70.48]) years, 47.85% men and 17.09% non-Hispanic Black. The overall weighted prevalence of CRNA was 7.94% (6.40–9.81), increasing from 3.09% (1.29–7.24) in 2012 to 13.69% (8.99–20.32) in 2018 and decreasing to 8.71% (3.82–18.67) in 2021. The prevalence of CRNA was higher among patients <65 years than those ≥65 years (11.78% vs 6.04%), and was more prevalent among patients with lower family income, with no insurance or public insurance, and with a greater comorbidity burden. The highest prevalence of CRNA was found among uninsured patients (18.54 [8.01–37.30]). Among patients <65 years, patients with CRNA had significantly lower utilisation of sodium glucose cotransporter-2 inhibitors and slightly lower use of beta blockers and ACEi/ARBs. The out-of-pocket cost for medication was higher among those with CRNA, especially cost on central nervous system medicines.

Conclusions CRNA was prevalent among patients with HF, disproportionately affecting those younger than 65 years, with lower socioeconomic status, and higher comorbidity burden. Interventions are needed to reduce financial burden and enhance medication adherence.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ To the best of our knowledge, this study represented the first study to systematically examine cost-related non-adherence (CRNA) among patients with heart failure (HF).
⇒ This study used nationally representative data from the Medical Expenditure Panel Survey.
⇒ Study limitations include the following: self-reported diagnosis of HF, small sample size and potential underestimation of CRNA prevalence.

INTRODUCTION

With the population aging and increasing burden of chronic diseases, the prevalence and associated mortality of heart failure (HF) are increasing in the US.[1 2] Medication is essential in managing HF symptoms and preventing exacerbations. Recent advances in pharmacotherapy have transformed the prognosis of HF,[3] and patient adherence is fundamental to the effectiveness of these medications. Despite the proven benefits of medications, medication non-adherence remains a critical issue among patients with HF, with non-adherence rates estimated to be between 29% and 63%, potentially higher than those observed in the general population.[4–8] This non-adherence is associated with increased risk of hospitalisation, exacerbation of symptoms, declines in physical function and higher healthcare costs.[9–12]

Factors contributing to medication non-adherence are multifaceted.[13] With the introduction of new and more expensive medications, cost could be a significant barrier to adherence. In 2022, it was estimated that annual out-of-pocket costs for HF with reduced ejection fraction were $2758 in the US,[14 15] posing significant affordability challenges and potentially leading to cost-related non-adherence (CRNA). Such financial strain may have a larger impact on patients with low socioeconomic status, who not only suffer disproportionately from HF but also experience poorer HF management outcomes.[16–18] Despite the critical implications of CRNA, there is a lack of comprehensive examination regarding its prevalence and determinants among patients with HF.

This study used nationally representative data to investigate the prevalence and potential determinants of CRNA in US adults with HF, aiming to identify subpopulations with HF who were more likely to experience CRNA and to identify barriers impeding medication adherence, thereby improving patient outcomes.

METHODS

Data source and study population

Our study used data from the Medical Expenditure Panel Survey (MEPS), an annual cross-sectional survey of the civilian non-institutionalised population in the US.[19] MEPS data are publicly available. We used data from the most recent 10 year period from 2012 to 2021 and included the household component and medical provider component.[20] The household component collects information on demographic characteristics, socioeconomic status, health insurance coverage, healthcare expenditure, access to healthcare services and medical conditions. The medical provider component collects data on the dates of healthcare services, use of medical care, charges and payments, and corresponding diagnoses and procedure codes for these services.[21] Our study population consisted of adults (≥18 years of age) with HF. In the MEPS, HF was self-reported and then encoded to International Classification of Diseases, 9th Revision (ICD-9-CM) or 10th Revision (ICD-10-CM) codes (428 or I50, respectively) by trained interviewers. The MEPS has been reviewed and approved by the Westat Institutional Review Board (MPA M-1531) and informed consent was obtained from each participant.

Study outcomes

From 2012 to 2017, participants were asked whether, in the previous year, they (1) were unable to get a prescription medication because they could not afford care, their insurance would not approve, cover or pay for their prescription, the doctor refused their insurance plan or (2) delayed getting a prescription medication because they could not afford care, their insurance would not approve, cover or pay for their prescription, the doctor refused their insurance plan. From 2018 to 2021, the survey questions were adjusted to whether participants (1) did not receive prescription medicine care because they could not afford it or (2) delayed getting prescription medicine for cost. A patient was defined as having CRNA if they reported either never getting medications or delaying getting medications because of costs. CRNA was defined as a composite measure combining these two indicators. Specifically, in MEPS, CRNA is not assessed at the level of individual medications and was defined as present if a respondent reported the above issues with at least one medication in our study.

Covariates

The analyses incorporated a range of sociodemographic and medical covariates. We included demographic characteristics including age, sex, race/ethnicity (Hispanic, non-Hispanic white, non-Hispanic black and others [including non-Hispanic Asian, non-Hispanic and other race, or multi-race]) and family income. The family income was classified into three categories according to the federal poverty line (FPL) from the Census Bureau: low income (≤100% of FPL), middle income (100%–400% of FPL) and high income (≥400% of FPL). We also included education (classified as less than high school, high school/general equivalency diploma and college or higher) and health insurance (any private, public only and uninsured).

Medical comorbidities were identified based on self-reported diagnoses from a medical provider and were encoded using Clinical Classifications Software, Clinical Classification Software Refined, ICD-9-CM or ICD-10-CM codes (online supplemental table S1). The current study included hypertension, diabetes, arthritis, chronic obstructive pulmonary disease (COPD), atherosclerotic cardiovascular disease, asthma, anaemia and cancer. We further included lifestyle factors including physical exercise and smoking history. A lack of physical exercise was defined as failing to engage in moderate to vigorous physical activity for at least half an hour on five or more days per week. Smoking status was categorised into current smoking or others.

Utilisation and annual out-of-pocket expenditures of medication

MEPS respondents reported the names of any prescribed medications procured at pharmacy. Following authorisation to access payment data, information about the date of prescription fulfilment, national drug code, medication name, medication strength, quantity, payment amount and sources of payment was obtained from pharmacies.[22] The medicines were categorised into therapeutic classes according to the Multum Lexicon classification scheme.[23] The Multum Lexicon includes all prescription and some non-prescription medications available in the US drug market and provides a 3-level nested category system that assigns a therapeutic classification to each drug and each ingredient of the drug. For example, the code for naproxen is central nervous system agents (level 1), analgesics (level 2) and nonsteroidal anti-inflammatory agents (level 3).

We examined the utilisation and the annual out-of-pocket expenditures of medications by therapeutic classes. We examined guideline-recommended medications for HF,[24] including beta-blockers, angiotensin-converting enzyme inhibitors (ACEi) or angiotensin receptor blockers (ARBs), angiotensin receptor-neprilysin inhibitor (ARNI), and sodium glucose cotransporter-2 (SGLT-2) inhibitors (see online supplemental table S2 for specific Multum Lexicon drug classification codes). We further examined cardiovascular agents, antihypertensive medications, diuretics, antidiabetic agents, antihyperlipidaemic agents, central nervous system agents, coagulation modifiers and other medications. Antihypertensive

medications included beta-blockers, ACEi, ARBs, calcium channel blockers, diuretics and combination therapies for hypertension.

Statistical analyses

Continuous variables were presented as mean (95% CI) and categorical variables were presented as percentage (95% CI). We first examined the prevalence of CRN among patients with HF. Because CRNA was a combination of two different components (ie, never get or delay getting prescription medication because of cost), we presented a composite measure of CRNA as well as its individual components. To assess the appropriateness of using the composite measure, we compared the characteristics of patients who never get prescription medications with those who delay getting them.

Given that patients ≥65 years are eligible for Medicare, which may lower cost-sharing and consequently the risk of CRNA, we presented the prevalence of CRNA by patients <65 or ≥65 years of age. Differences in characteristics between patients with and without CRNA were compared using t-tests or χ^2 tests, as appropriate. We used bivariable and multivariable logistic regression models to examine the association between patient characteristics and CRNA. Age was included as a binary variable in models, and we tested for interactions by age groups. Our analyses combined multiple years of data and used variance structure and survey weights as recommended by MEPS.[25] All analyses accounted for the complex survey design of MEPS and incorporated survey weights. We used the Taylor series (linearisation) method to obtain SE estimates and corresponding CI as recommended by the Agency for Healthcare Research and Quality.[26] All statistical analyses were conducted using STATA/SE V.18.0. A two-sided p value <0.05 was considered statistically significant.

In sensitivity analyses, we used data from 2012 to 2017 only to avoid potential impacts of changes in the questionnaire and the COVID-19 pandemic and replicated the above-mentioned analyses.

Patient and public involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

RESULTS

Study population

In MEPS from 2012 to 2021, 1864 adults reported ever receiving a diagnosis of HF. After excluding those with incomplete data on CRN, the study included 1753 patients with HF (online supplemental figure S1). The mean age was 69.36 (95% CI, 68.23 to 70.48) years, 47.85% (44.03–51.71) were men and 17.09% (14.60–19.90) were non-Hispanic Black (online supplemental table S3).

National estimates and temporal trends of CRNA

Among patients with CRNA, 57.6% reported both never getting and delaying getting medications due to costs, 18.1% reported only never getting medications, and 24.3% reported only delaying getting medications. We found no significant differences in patient characteristics across these three groups (online supplemental table S4). Therefore, we proceeded with the use of the composite measure of CRNA.

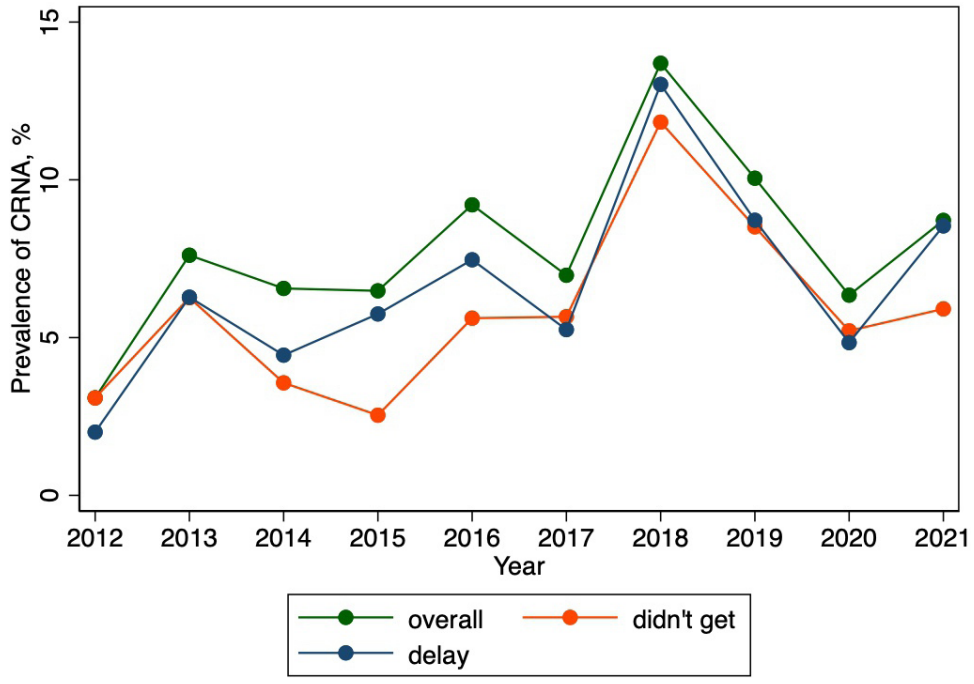

Figure 1 Temporal trend in the prevalence of cost-related non-adherence among patients with heart failure. CRNA, cost-related non-adherence.

Table 1 Prevalence and 95% CI of cost-related non-adherence across subgroups among patients with heart failure

	Age<65 y (n=644)	Age≥65 y (n=1109)
Weighted %	11.78 (8.57–15.99)*	6.04 (4.54–8.01)*
Gender		
Male	10.64 (6.56–16.80)	3.99 (2.42–6.52)*
Female	12.88 (8.73–18.61)	7.88 (5.47–11.23)*
Race/ethnicity		
Hispanic	7.25 (2.52–19.12)	8.04 (3.09–19.31)
Non-Hispanic White	12.25 (7.67–18.99)	6.10 (4.38–8.43)
Non-Hispanic Black	10.71 (6.89–16.28)	6.33 (3.58–10.96)
Others†	15.35 (6.12–33.53)	2.20 (0.53–8.73)
Education		
Less than high school	4.87 (1.75–12.81)	9.77 (4.74–19.08)
High school/GED	13.99 (8.77–21.59)	7.17 (4.61–10.98)
College or higher	9.22 (3.05–24.72)	5.56 (2.73–10.98)
Family income		
Less than 100% FPL	12.78 (8.53–18.72)*	8.61 (4.15–17.03)*
100%–400% FPL	14.26 (9.55–20.76)*	7.70 (5.55–10.58)*
≥400% FPL	2.79 (0.80–9.31)*	2.45 (1.09–5.41)*
Health insurance coverage		
Any private	9.94 (6.03–15.98)	3.50 (2.09–5.82)*
Public only	12.79 (8.36–19.06)	8.31 (5.88–11.60)*
Uninsured	18.54 (8.01–37.30)	‡
Comorbidities		
Hypertension		
No hypertension	9.97 (4.12–22.19)	1.59 (0.57–4.34)*
Hypertension	12.15 (8.78–16.57)	6.73 (5.00–9.01)*
Diabetes		
No diabetes	10.91 (6.79–17.08)	4.76 (3.18–7.06)
Diabetes	12.80 (8.38–19.07)	7.81 (5.18–11.60)
Arthritis		
No arthritis	9.96 (5.46–17.49)	4.28 (2.51–7.21)
Arthritis	13.21 (9.39–18.28)	6.76 (4.85–9.37)
COPD		
No COPD	11.11 (7.58–16.01)	4.33 (3.04–6.14)*
COPD	13.35 (8.25–20.90)	11.39 (7.45–17.05)*
ASCVD		
No ASCVD	10.08 (6.15–16.09)	5.54 (3.99–7.66)
ASCVD	12.78 (8.69–18.40)	5.44 (3.90–7.52)
Asthma		
No asthma	9.45 (6.52–13.50)	5.54 (3.99–7.66)
Asthma	16.37 (9.86–25.94)	8.28 (4.77–14.00)
Anaemia		
No anaemia	11.65 (8.30–16.13)	6.04 (4.48–8.09)
Anaemia	13.40 (5.85–27.80)	6.08 (1.87–18.06)
Cancer		
No caner	11.86 (8.30–16.67)	6.77 (4.80–9.47)
Cancer	11.41 (5.86–21.03)	4.89 (3.04–7.77)

Continued

Table 1 Continued

	Age<65 y (n=644)	Age≥65 y (n=1109)
Comorbidities, n		
n<2	5.83 (1.44–20.81)	3.14 (0.43–19.52)
n≥2	12.09 (8.57–15.99)	6.09 (4.55–8.11)
Physical activity		
Sufficient	9.42 (5.21–16.45)	4.34 (2.54–7.31)
Insufficient	13.11 (9.22–18.29)	6.95 (5.02–9.56)
Smoke status		
Non smoker	11.19 (7.53–16.31)	5.11 (3.70–7.02)*
Current smoker	13.91 (7.95–23.22)	19.39 (10.28–33.55)*

*p<0.05 for t-test or χ^2 test.
†The sample size is too small to draw any meaningful conclusions.
‡Others include Non-Hispanic Asian, Non-Hispanic and other race or multi-race.
. ASCVD, atherosclerotic cardiovascular disease; COPD, chronic obstructive pulmonary disease; FPL, federal poverty line; GED, general equivalency diploma.

Overall, the prevalence of CRNA was 7.94% (6.40–9.81). Specifically, 5.83% (4.52–7.49) of patients reported never getting prescription medicine and 6.69% (5.26–8.48) reported delaying getting prescription medicine because of cost. The prevalence of CRNA increased from 3.09% (1.29–7.24) in 2012 to 13.69% (8.99–20.32) in 2018 and decreased to 8.71% (3.82–18.67) in 2021 (figure 1). Similar trends were observed for both components of CRNA.

Prevalence of CRNA by patient characteristics

Overall, patients <65 old were about twice as likely to report CRNA compared with those ≥65 years (11.78% vs 6.04%, p=0.002, table 1). Among patients aged <65 years, the prevalence of CRNA was significantly higher among patients with lower income (12.78% for family income <100% FPL and 14.26% for income 100–400% FPL vs 2.79% for income ≥400% FPL, p=0.01, table 1). Although not statistically significant, higher prevalence of CRNA was observed among patients of other races, patients with lower education, with no insurance or public insurance only, and with comorbidities than their counterparts. The highest prevalence of CRNA was found among uninsured patients (18.54% [8.01–37.30]).

While among patients ≥65 years, the prevalence of CRNA was higher among females, patients with lower income, and patients with public insurance only (p<0.05 for all, table 1). Additionally, the prevalence of CRNA was significantly higher among patients with hypertension, COPD and current smokers (p<0.05 for all).

In bivariable analyses, younger age, lower income and public insurance were associated with significantly higher risk of CRNA (p<0.05 for all, online supplemental figure S2). However, in multivariable analyses, we did not find any significant association between patient characteristics and CRNA. We did not find significant interactions by age.

Utilisation and annual out-of-pocket expenditures on medicines

Among patients <65 years, the use of SGLT2 inhibitors was low and was even lower among patients with CRNA than those without (0 for with CRNA vs 1.70% for without CRNA, figure 2A). The utilisation of beta blockers and ACEi/ARBs was also lower in patients with CRNA, but the difference was not statistically significant. While for patients ≥65 years, patients with CRNA reported greater use of cardiovascular agents (100.00% vs 97.88%), antihyperlipidemic agents (82.80% vs 63.14%), and central nervous system medicines (82.49% vs 59.71%, figure 2B).

For patients <65 years, the annual out-of-pocket expenditures for medication were higher for patients with CRNA than those without ($944.82 vs $586.77, figure 3A), but the difference was not statistically significant. For specific medications, the greatest difference was found in central nervous system medications ($444.86 vs $62.71, p=0.04). Patients with CRNA spent slightly more on ARNIs, antihyperlipidaemic and other medications and spent less on antidiabetic agents ($104.95 vs $372.56). While for patients ≥65 years, patients with CRNA spent less on ARNI (181.39 vs 385.52, p=0.03, figure 3B). We did not find a significant difference in out-of-pocket expenditures for other medications.

Sensitivity analyses

In sensitivity analyses using data from 2012 to 2017 only, the overall findings were consistent with the main analyses. In bivariable analyses, younger age, lower income level and public insurance were associated with significantly higher risk of CRNA (online supplemental table S5 and figure S3). However, we did not find significant associations between patient characteristics and risk of CRNA in multivariable analyses.

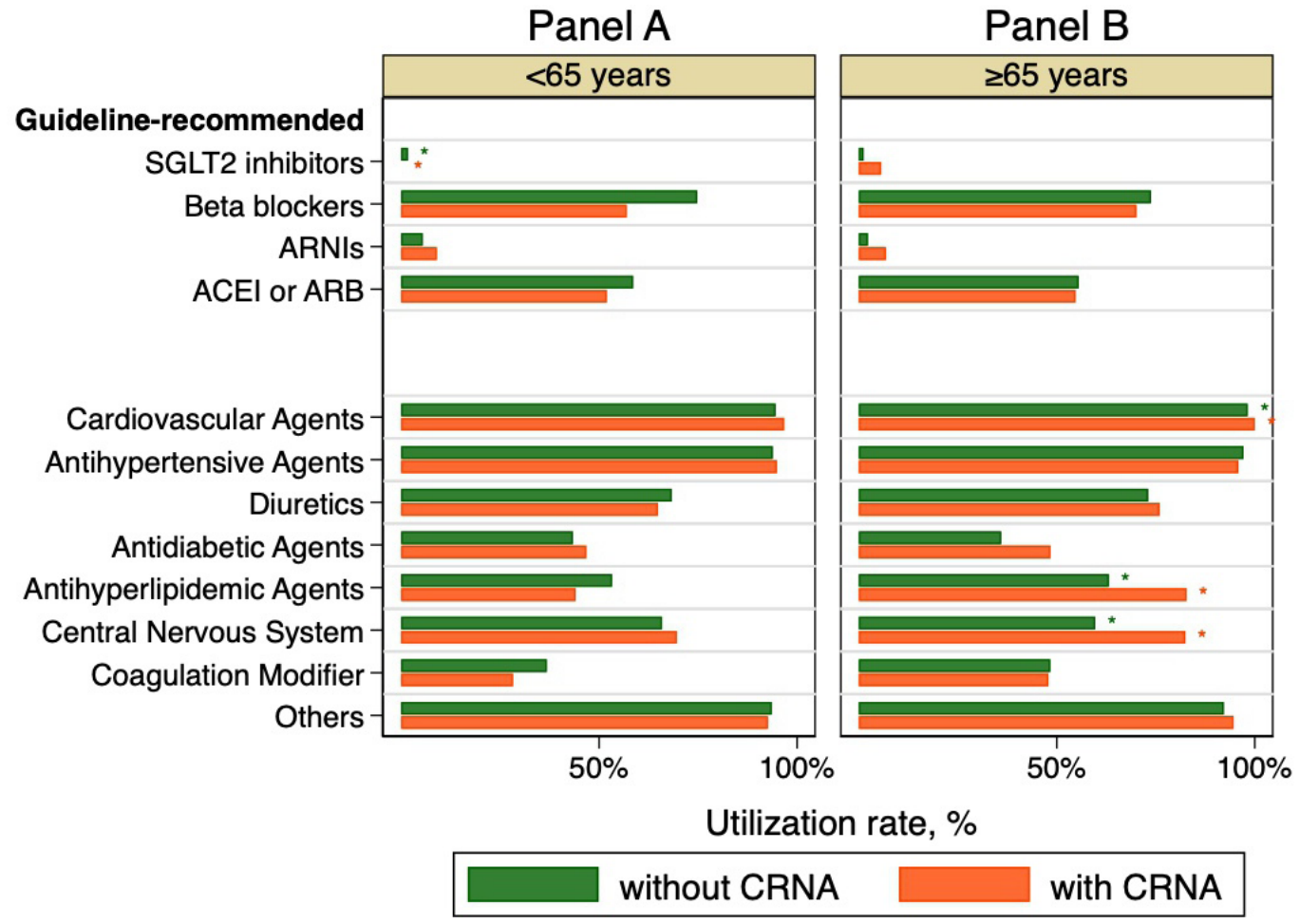

Figure 2 Utilisation of medicines among patients with heart failure by cost-related non-adherence. ACEI, Angiotensin Converting Enzyme Inhibitors; ARB, Angiotensin Receptor Blocker; ARNIs, Angiotensin-receptor neprilysin inhibitors; CRNA, cost-related non-adherence. *p<0.05.

DISCUSSION

Using nationally representative data from the US, we found that 7.8% of patients with HF reported CRNA, with increasing prevalence over the past decade. Younger than 65 years, lower socioeconomic status, and higher comorbidity burden may be associated with a higher risk of CRNA. CRNA may be associated with lower utilisation of guideline-recommended medications. Out-of-pocket expenditures for certain medications, such as central nervous system agents, may contribute to the higher medication costs in patients with CRNA.

The prevalence of CRNA was notably higher among patients with HF younger than 65 years, those with lower socioeconomic status, and those with a greater comorbidity burden. These findings are consistent with previous research conducted in the general population[4 9] and among patients with other chronic diseases.[27–30] It is concerning that these subgroups also tend to experience poorer HF outcomes,[2 15 18] suggesting that CRNA may contribute to these disparities and highlighting the critical need for these patients to access effective guideline-directed therapies. Our results further underscored the vulnerability of patients with HF who lack sufficient insurance coverage for long-term medication treatment. The prevalence of CRNA was higher among uninsured patients and was almost double in patients <65 years compared with those ≥65 years. Even among patients ≥65 years, who typically have Medicare coverage, the prevalence of CRNA was lower in those with private insurance, suggesting underinsurance among older adults.

We found that the out-of-pocket costs for prescription medications were higher among patients with CRNA, supporting that the financial burden associated with prescription medications is a significant barrier to medication adherence among patients with HF. For many patients with HF, they require medications that are expensive brand-name drugs prescribed as part of lifelong, guideline-directed medical therapy,[14] which can lead to substantial cost-sharing and heavy financial burden. It is worth mentioning that CRNA led to underutilisation of guideline-recommended medications. This underscores the urgent need for interventions to alleviate the financial burden from prescription medications in patients with HF.

Policies such as Medicare Part D and the Affordable Care Act have improved the affordability of prescription

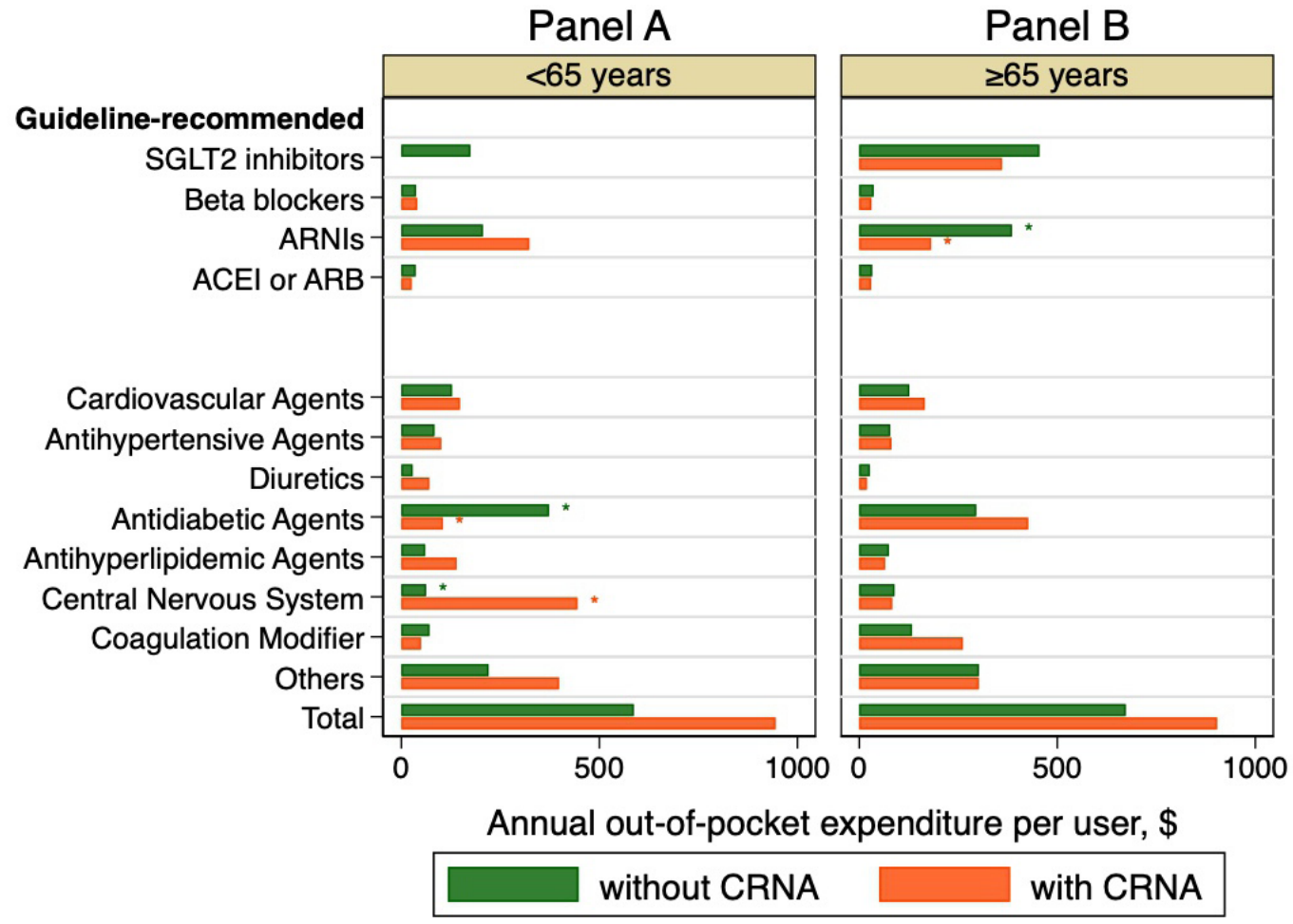

Figure 3 Annual out-of-pocket expenditures on medicines among patients with heart failure by cost-related non-adherence. ACEI, Angiotensin Converting Enzyme Inhibitors; ARB, Angiotensin Receptor Blocker; ARNIs, Angiotensin-receptor neprilysin inhibitors; CRNA, cost-related non-adherence. *p<0.05.

medications.[31–34] The implementation of the Inflation Reduction Act is expected to further reduce out-of-pocket costs of prescription medication and enhance medication adherence.[14] Some commonly used medications for HF are included in the first 10 drugs eligible for price negotiations.[35] We found that for patients <65 years, the largest difference in out-of-pocket expenditure was for central nervous system medications. Our results called for attention to the utilisation and affordability of these medications.

To the best of our knowledge, our study represented the first study to systematically examine CRNA among patients with HF. Our study has a few limitations that warrant consideration. First, we relied on self-reported diagnosis of HF and were not able to differentiate between HF with reduced or preserved ejection fraction, which can significantly impact prescription medication costs. Second, when facing financial difficulties, some patients may switch to a lower-cost medication to save money, and we may underestimate the true prevalence of CRNA. Third, the small sample size may have limited our ability to detect the associations between patient characteristics and CRNA, such as the difference by races and ethnicities found in previous studies, as well as potential interactions by age.[7 36] In addition, the small sample size limited our ability to make comparisons across different types of CRNA. Fourth, patients with HF may need multiple medications, but our definition of CRNA does not differentiate between patients who experience difficulty affording a single medication versus those who face financial barriers across multiple prescriptions. Fifth, our study involved multiple statistical comparisons and we opted to use p<0.05 as the threshold due to the small sample size, which may increase the risk of type I error.

CONCLUSIONS

In summary, our study highlighted that CRNA was prevalent among patients with HF, particularly affecting those with lower socioeconomic status and those without or with insufficient insurance. Actions are needed to mitigate financial barriers faced by these patients and to improve medication adherence, and ultimately improve patient outcomes.

Contributors RL and BL were involved in the conception, design, conduct of the study, and the analysis. All authors were involved in interpretation of the results. RL and BL wrote the first draft of the manuscript, and all authors edited, reviewed, and approved the final version of the manuscript. RL is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by the MEPS has been reviewed and approved by the Westat Institutional Review Board (MPA M-1531). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available in a public, open access repository. The data underlying this article are publicly available in https://meps.ahrq.gov/mepsweb/data_stats/download_data_files.jsp. Statistical codes are available in https://github.com/RanLi0826/CRN.

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