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Healthcare performance for patients with heart failure in Iran: addressing the tip of the iceberg

Fateme Gorgani[1*], Mohammadreza Naderian[1,2], Shahab Khatibzadeh[3], Ahmad Amin[4], Yosef Farzi[1], Mohammad Reza Beyranvand[5], Majid Haghjoo[6], Mitra Modirian[1], Nazila Shahbal[7], Mehrdad Azmin[1] and Saeid Shahraz[8]

Abstract

Background Chronic diseases, such as heart failure with reduced ejection fraction (HFrEF), remain significant factors in the healthcare burden in Iran. Healthcare systems must have comprehensive data on the current usage, costs, and quality of care to tackle these challenges and formulate strategic plans effectively.

Methods The study included 209 patients with a mean age of 58 years (SD = 16.5) who met the inclusion criteria of having an ejection fraction of less than 40% and a confirmed diagnosis of HFrEF. This study used nationally representative data to assess the healthcare usage, costs, and quality of HFrEF management in Iran.

Results The most used services were medication dispensing (76%) and outpatient visits (53%), while rehabilitation (3%) and homecare (2%) were used less frequently. The annual per-patient direct medical cost was $1,464, with $308 (21%) paid out-of-pocket (OOP). Hospitalization accounted for most of the total cost (68%), and pharmacy expenses comprised the largest portion of OOP payments (46%). Echocardiography was performed for 91.1% of patients upon admission. Only 71.6% of patients had arrangements for a cardiology visit within seven days following hospital discharge. Additionally, only 67.5% of patients received prescriptions for angiotensin-converting enzyme inhibitors or angiotensin receptor blockers, and 85% were prescribed beta-blockers.

Conclusion Patients with heart failure in Iran face challenges in accessing adequate cardiac care, including a lack of care continuity and advanced cardiac services. The study provided an essential benchmark for future healthcare reform.

Keywords Heart failure, Healthcare utilization, Healthcare Quality, Healthcare costs, Iran

*Correspondence:
Fateme Gorgani
Gorgani_f76@yahoo.com
[1]Non-Communicable Diseases Research Center, Endocrinology and Metabolism Population Sciences Institute, Tehran University of Medical Sciences, Tehran, Iran
[2]Cardiovascular Diseases Research Institute, Tehran Heart Center, Tehran University of Medical Sciences, Tehran, Iran
[3]Heller School of Social Policy and Management, Brandeis University, Waltham, MA, USA
[4]Cardiogenetics Research Center, Rajaie Cardiovascular Medical and Research Center, Iran University of Medical Sciences, Tehran, Iran
[5]Department of Cardiology, Taleghani Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran
[6]Cardiac Electrophysiology Research Center, Rajaie Cardiovascular Medical and Research Center, Iran University of Medical Sciences, Tehran, Iran
[7]School of Agriculture and Food Science, The University of Queensland, Brisbane, Australia
[8]Tufts Medical Center, Institute for Clinical Research and Health Policy Studies, Boston, MA, USA

Key learning points

What is already known.

- Heart failure with reduced EF is a significant contributor to the burden of disease in Iran.
- Administrative data on the types of services provided and their associated costs need to be collected.

What this study adds.

- While substandard hospital care is being provided, there needs to be more continuity in post-acute care.
- Additionally, outpatient cardiac care is underutilized, which corresponds with a high hospital readmission rate.
- This study provides the first benchmark on nationwide heart failure with reduced EF care statistics and can serve as a basis for future policy efforts to improve HFrEF care.

Introduction

HF is a chronic condition that affects a large number of people worldwide, with an estimated prevalence of around sixty-four million individuals globally [1]. It is a significant health burden and one of the leading causes of hospitalization. In the United States, HF accounts for at least 2% of the overall health expenditure [2]. Moreover, based on a comprehensive study in the United States, the annual median medical costs for HF care were estimated to be $24,383 per patient, with HF-specific hospitalizations primarily contributing to these expenses [3]. The incidence of HF is increasing partially but significantly due to better care of acute cardiac events and an aging population [4]. Healthcare quality assessment has become a primary objective in developed countries to improve patient experience and outcome, especially for non-communicable diseases (NCDs) such as HF [5–9].

Epidemiological and clinical features of HF have shown to be different between high-income and low and middle-income countries (LMIC). Increasing incidence, younger age of onset, lower reports of HF with preserved ejection fraction, and different distribution of underlying etiologies are prominent features of HF in LMIC [1, 10]. Insufficient data from these regions can lead to challenges for healthcare workers and policymakers since the current policies and guidelines are mainly based on information from Western countries [11].

About half of heart failure patients have reduced ejection fraction [12]. Evidence indicates that worsening heart failure with reduced ejection fraction (HFrEF) leads to a significantly worse prognosis. The 5-year survival rate for these patients is less than 50% [13]. Despite regularly taking multiple medications, many HFrEF patients do not receive guideline-recommended treatments [12].

Iran has experienced an epidemic of NCDs with an increased incidence of HFrEF risk factors. However, to our knowledge, a nationwide study on the epidemiological features of HFrEF in Iran has yet to be available [14]. Additionally, there are no systematic national assessments of healthcare quality and cost for patients with HFrEF in the country. In a broader scope, few investigations are available in the Middle East and North Africa region [15]. We have proposed conducting a pilot study called the Iran Quality of Care in Medicine Program (IQCAMP) to address this issue. The IQCAMP initiative aims to investigate patients' experiences during this period, encompassing all costs associated with the disease, including direct, total medical, and non-medical costs [16].

Healthcare utilization refers to the number and types of services provided to a patient [17]. While healthcare costs are complex and viewed from various perspectives, like patients, providers, insurance companies, governments, and society, they can be categorized as direct or indirect costs [18]. The quality of healthcare is mostly determined by how well the current practices align with the guidelines and standards of care. It can be measured by calculating the percentage of services that meet the gold standard of care. If the quality of care is low, it may lead to hospital readmission, increased healthcare utilization, and higher cost of care [19]. The IQCAMP initiative aims to investigate patients' experiences during this period, considering all costs associated with the disease, including direct medical costs, total medical costs, and non-medical costs. The research demonstrates that it is possible to conduct evaluations without relying on nationwide administrative data.

As part of the IQCAMP study, we sought to investigate the quality and cost of healthcare in patients with HFrEF in a nationwide setting.

Materials and methods

Study design and population

In a three-month-long longitudinal survey, patients with HFrEF were recruited and followed up during four visits, including a baseline visit, at a one-month interval. If a patient fails to participate in a follow-up visit, the research team will make at least three phone calls to reduce the loss of follow-up as much as possible. The survey's prospective design with a monthly recall period is intended to minimize recall bias. The protocol has been approved by the institutional review board of the Ministry of Health and Medical Education of Iran and is described in detail elsewhere. Informed written consent has been obtained from all enrolled patients [16]. The

sampling strategy used in the survey has previously been reported [20]. In brief, a data mining approach was used to conduct a stratified sampling, reducing the number of provinces considered for sampling from 31 to 8. The top one or two hospitals with the highest referral rates were chosen in each selected province. Then, patients were selected from the outpatient clinics of the selected hospitals using the convenience sampling method.

Setting

Patients were enrolled in the outpatient cardiology clinics of the top one or two hospitals with the highest referral rates in each selected province between 2017 and 2019. Since previous investigations suggested little data on ambulatory services compared to the inpatient setting, patients were recruited from outpatient services. At baseline, after identifying potentially eligible patients, the patients were registered in an in-house system, and a trained nurse obtained the initial information. The nurse obtained informed consent after confirming that the patients met the inclusion criteria and conducted a structured interview to collect information on the healthcare quality that the patients had received in ambulatory and inpatient services during the past 12 months. If a patient had been hospitalized in the past year, the hospital records were reviewed to assess quality of care (QoC) indicators during the hospitalization.

After the baseline data gathering, each patient was followed up for three months at monthly intervals. For each follow-up, patients were asked to come to the clinic and provide records of the inpatient, outpatient, laboratory, other diagnostic, rehabilitative, pharmaceutical, home care, and medical equipment services they had received within the past month. A trained nurse also conducted a structured interview to assess QoC measures during the patients' inpatient and ambulatory services during the past month. The research team called patients who missed the monthly follow-ups three times to reduce losses to follow-up.

Participants

The study enrolled patients who met specific criteria, which included having an EF ≤ 40% on echocardiography, experiencing cardiovascular-related signs and symptoms such as chest pain, abdominal pain of cardiovascular origin, exercise-induced dyspnea, cardiovascular syncope, or palpitation, and having confirmation of the clinical signs and symptoms by a board-certified cardiologist. In addition, their contact information had to be available in the clinic database. Patients who did not meet the inclusion criteria, were initially misdiagnosed with HFrEF, or opted out of the study were excluded.

Outcome variables

Healthcare quality

The primary focus was on assessing the quality of healthcare. A committee of experts from various fields, including cardiologists, primary care providers, and epidemiologists, was formed to achieve this goal. They developed quality indicators by selecting from quality measures endorsed by the National Quality Forum (NQF) or identified through a literature search based on their clinical experience. To ensure the selected quality indicators were appropriate, they met specific criteria such as scientific acceptability, reliability and reproducibility, relevance, and feasibility.

Cost

The cost of care was analyzed in three categories: direct medical, direct non-medical, and indirect costs. For direct medical costs, data was collected via self-reports and hospital invoices and included inpatient costs, diagnostic, laboratory, home care, medical equipment, medication, and rehabilitation costs. Direct non-medical costs included transportation, accommodation, and childcare costs during hospitalizations. Indirect cost was measured as a reduction in earnings due to limitations caused by the disease and was calculated from three viewpoints: (1) time wasted in waiting to receive care (2), absenteeism from work, and (3) productivity loss as a result of cause-specific disability. Data for indirect costs were obtained through a self-report questionnaire. The indirect costs were calculated based on the minimum wage in the country to offer a conservative estimate of the additional burden. We used invoices and self-report questionnaires to calculate direct medical costs, considering the different shares of out-of-pocket costs and costs paid by health insurance.

To confirm our cost documentation method, we employed sensitivity analysis by comparing the calculated total costs based on invoices and self-reports with the calculated total cost estimated based on national tariffs for each service. We found a high consistency between the two methods (intraclass correlation coefficient > 0.7) [21].

Healthcare utilization

We used a questionnaire to evaluate the utilization of therapeutic, diagnostic, and patient support services, including inpatient/outpatient visits, laboratory/diagnostic services, rehabilitation services, pharmaceutical services, medical equipment utilization, and home care.

Measurement

All questionnaires were administered using a device provided by us. After multiple rounds of usability testing, we gave the devices to nurses for data collection. All data

was transmitted to study servers through encrypted protocols to ensure confidentiality.

The devises saved encrypted data locally on the external memory of each tablet for two reasons. Firstly, to ensure access to the data in case of any software or tablet issues. Secondly, to capture data even in offline mode and then send it to study servers when internet connectivity was re-established.

Study ethics

The IQCAMP Survey received approval from the ethics committee of the Iran National Institute for Medical Research Development (NIMAD) in Tehran, Iran (Ethics Code: IR.NIMAD.REC.1395.003).

Statistical analysis

We assumed that patients with HFrEF had similar monthly quality indicators, healthcare utilization, and cost. We considered the healthcare quality, cost, and utilization of one patient over a three-month follow-up period to be equivalent to that of three patients over a one-month follow-up period. Thus, the 3-month follow-up of 209 patients was equivalent to 627 patient-visits (209×3).

For cost calculation, the average cost estimated for each month was multiplied by 12 to calculate the average annual cost. The Iranian Rials were converted to US dollars using purchasing power parity (PPP). The number of absent days from work due to the presence of HFrEF was multiplied by the minimum daily wage to calculate absenteeism to report indirect costs interpretably. To measure loss of productivity, the patient was asked how much less they think they are earning due to this disease.

The quality indicators were presented as the percentage of patients receiving care. All statistical analyses were performed using the R statistical package v 4.0.4 (http://www.r-project.org/, RRID: SCR_001905).

Table 1 Sociodemographic characteristics of participants

Characteristics		Number (%)
Sex	Female	83 (39.7%)
	Male	126 (60.3%)
Age	18–35	11 (5.3%)
	36–65	97 (46.4%)
	>=65	83 (39.7%)
Education	No formal literacy	38 (18.2%)
	Elementary school	50 (23.9%)
	Middle/Highschool	22 (10.5%)
	Diploma	51 (24.4%)
	Associate/Bachelor degree	26 (12.4%)
	Masters/Doctoral degree	4 (1.9%)
Wealth index	Very low	35 (17.2%)
	Low	38 (18.7%)
	Intermediate	49 (24.1%)
	High	46 (22.7%)
	Very high	35 (17.2%)
Comorbidities	Positive history of hypertension	107 (51.9%)
	- Receiving medication for hypertension	105 (98.1%)
	Positive history of hyperlipidemia	65 (28.0%)
	- Receiving medication for hyperlipidemia	33 (61.1%)
	Positive history of diabetes mellitus	65 (31.7%)
	- Receiving medication for diabetes mellitus	58 (89.2%)
	Positive history of MI	122 (62.2%)
	Positive history of CKD	27 (13.2%)
	- Receiving medication for CKD	18 (75.0%)
	Positive history of ever smoking	110 (48.4%)

Total number of 209 patients recruited, Wealth index is categorized into five quintiles of Very high, High, intermediate, Low or very low based on individual income levels and financial assets, Comorbidities are self-reported

Results

Participants

A total of 209 patients were enrolled in the study, with a mean age of 58±16.5 years and a range of 18 to over 65 years. Of the enrolled patients, 60.3% were male. Among the enrolled patients, 83.3% participated in the first follow-up, and ultimately 77.9% completed all three follow-ups. Among these patients who failed to attend the follow-up visits, six patients (3%) passed away during the study period.

The most common comorbidity observed in the enrolled patients was a history of myocardial infarction (62.2%), followed by hypertension (51.9%) and diabetes mellitus (31.7%). Nearly all patients (98.1%) received treatment for high blood pressure, and the majority (89.2%) were treated for diabetes. 48.4% of the participants had a history of smoking. Table 1 summarizes the demographic features and comorbidities of the enrolled participants.

Healthcare utilization

Patients' utilization was categorized into eight distinct categories: outpatient visits, inpatient stays for those hospitalized, equipment purchased, imaging and diagnostics, laboratory tests, medications, rehabilitation, and home care. The most utilized services were medication purchases, with an average of 265 times per month (177 times among men and 88 times among women), and 76% of patients filled prescriptions. The second most utilized type of healthcare service was outpatient visits, with an average of 157 times per month (101 times among men and 56 times among women).

Only three patients (2%) utilized rehabilitation services, and five patients (3%) utilized home care services. Lab tests, imaging and diagnostics, and home care services were more frequently utilized by women, whereas

Table 2 Number of Patients' monthly utilization of services by category

Utilization category	Total (*N*=175)			Male (*N*=107)			Female (*N*=68)		
	Total number of utilizing patients (%)	Total number of events utilized	Event rate	Total number of utilizing patients (%)	Total number of events utilized	Event rate	Total number of utilizing patients (%)	Total number of events utilized	Event rate
Inpatient	30 (17%)	38	0.18	20 (19%)	24	0.19	10 (15%)	14	0.17
Outpatient	94 (53%)	157	0.75	61 (57%)	101	0.8	33 (48%)	56	0.67
Laboratory	41 (23%)	61	0.29	22 (20%)	33	0.26	19 (28%)	28	0.34
Imaging and diagnostics	30 (17%)	38	0.18	18 (17%)	22	0.17	12 (18%)	16	0.19
Pharmacy	133 (76%)	265	1.27	87 (81%)	177	1.4	46 (68%)	88	1.06
Equipment	7 (4%)	8	0.04	7 (7%)	8	0.06	0 (0%)	0	0.0
Rehabilitation	3 (2%)	3	0.01	3 (3%)	3	0.02	0 (0%)	0	0.0
Home Care	5 (3%)	5	0.02	2 (2%)	2	0.02	3 (4%)	3	0.04

The imaging and diagnostics category includes patient's expenses such as ECG, echocardiography, chest X-ray, sonography, exercise tolerance test, etc, Equipment category includes patient's expenses such as pulse oximeter, pacemaker, implantable cardioverter defibrillator, etc, Rehabilitation category includes patient's expenses such as chest physiotherapy, four limb physiotherapy, etc.

Table 3 Direct medical cost per major service categories–study based

Services	Out-of-Pocket Payment			Total Payment (OoP + Insurance)		
	Mean (SD)	Median (IQR)	The proportion of OoP (%)	Mean (SD)	Median (IQR)	The proportion of total cost (%)
Direct cost						
Inpatient	105 (2,738)	891 (1,396)	34%	1,003 (22,782)	11,371 (23,105)	68%
Outpatient Visits	16 (183)	42 (41)	5%	78 (449)	165 (120)	5%
Laboratory	11 (228)	99 (192)	3%	17 (310)	197 (284)	1%
Diagnostic	10 (400)	107 (129)	3%	45 (1,130)	579 (1,053)	3%
Rehabilitation	0 (0)	0 (0)	0%	0 (0)	0 (0)	0%
Pharmacy	141 (621)	510 (716)	46%	311 (1,015)	562 (1,004)	21%
Equipment	4 (101)	1,002 (72)	1%	11 (539)	708 (973)	1%
Home service	22 (6,196)	0 (5,366)	7%	0 (0)	0 (0)	0%
Total	308			1,464		
Indirect cost						
Non- health				302 (302)	154 (390)	
Absenteeism				1,423 (1,423)	670 (872)	
Lower productivity				14,397 (14,397)	14,309 (17,886)	
Wasted time				713 (713)	674 (350)	
Total				31,255		

Costs are calculated using the 2018 Rials to the Dollars exchange rate, The analysis has been done for 209 patients who have filled all three follow-ups are included, The average cost estimated for each month was multiplied by 12 to calculate the average annual cost. Absenteeism includes absenteeism for the patients, their caregivers as a family member, and childcare by a family member (non-paid), 5- Lower productivity includes loss of productivity for the patients and their caregivers as a family member, 6- Wasted time includes the value of time lost in waiting rooms, both for the patients and their caregiver as a family member

men had higher utilization rates for hospital admissions, outpatient visits, equipment, rehabilitation, and medications (refer to Table 2 for details).

Healthcare costs

An analysis of health expenditure data revealed that in 2018, the average total direct medical cost associated with HF was $1,464 Purchasing Power Parity (PPP) dollars. The annual PPP-adjusted average out-of-pocket share of direct costs was $308, representing approximately 21% of the total cost. Notably, while 68% of direct total costs were attributable to hospitalization and inpatient services, most out-of-pocket costs were derived from pharmacy services, comprising 46% of the out-of-pocket payment share.

Moreover, the average indirect cost resulting from HFrEF was estimated at $31,255, with approximately 86% attributed to loss of productivity. Direct and indirect costs of HF are summarized in Table 3, providing a comprehensive overview of the financial impact of this condition on affected populations.

Healthcare quality

The quality measures for HFrEF management were evaluated. In our study on inpatient care, it was noted that a large proportion of patients received echocardiography and underwent ejection fraction measurement upon admission to the hospital, with a utilization rate of 91.1%. However, this rate decreased to 58.8% during the follow-up phase. Furthermore, only 59.1% and 14.5% of patients received Troponin and BNP level measurement during their hospitalization, respectively. 93.4% of patients received a cardiologist visit due to exacerbation of HFrEF symptoms, and 33.8% of them were readmitted to the hospital due to worsening HFrEF during the past year.

The study found that 98.1% of patients with HFrEF were prescribed hypertension medication, followed by HFrEF medication (97.6%) and diabetes medication (89.2%). 29.0 (60.4%). 67.5% of patients were prescribed ACE inhibitors or ARBs, while 85.5% were prescribed beta-blockers at discharge. Both classes of medications showed an increase in prescription rates during the follow-up phase. Also, 94.2% of respondents reported receiving instructions on medication use from their consulting physicians.

In ambulatory care settings, Only 71.6% of patients had arrangements for a cardiology visit within seven days post-discharge from the hospital.90.8% of respondents received a heart rate assessment through pulse or stethoscope during a visit from their physician within the past year, while examinations for edema, fluid retention, and foot and ankle assessment were performed for only 56.2% of patients during their visit in the past year. However, this rate increased to 84.3% during follow up phase. Review of requested tests in the previous visit by the physician was 77.6%, which decreased to 63.3% during follow up phase. It is crucial to note that the reception of proper instructions on managing worsening symptoms like shortness of breath, edema, or reduced activity capacity from healthcare professionals decreased from 59.7 to 45.5% during follow up phase.

In terms of lifestyle modifications, it is essential to emphasize that 87.9% of patients received a consultation from their physician on appropriate diet and salt restriction for heart failure management within the past year, which increased to 94.2% during follow up phase, but only 32.2% received information about daily weight monitoring. Also, 77.7% and 71.6% of patients received a consultation on the importance of physical activity and smoking cessation during the same time period, respectively. Also, the results reveal a difference in the rate of smoking cessation consultation between males (76.4%) and females (57.9%), with a noticeably lower cessation rate observed among females (refer to Table 4 for details).

Discussion

The discussion revolves around two crucial healthcare gaps in HFrEF care: the underutilization of HFrEF care services and the low quality of provided services.

Underutilization of services

In Iran, hospital care for HFrEF patients follows standard protocols, but advanced interventions like continuous inotropic infusions, mechanical circulatory support devices, and cardiac transplantation are usually unavailable [22]. Financial constraints or lack of expertise contribute to the scarcity of advanced services [22]. This issue is likely widespread in neighboring countries. For example, in Saudi Arabia, the utilization rates for cardiac resynchronization therapy (CRT) and intracardiac defibrillation (ICD) appeared suboptimal, with rates of 8% for CRT and 29% for ICD [23]. According to the Gulf Heart Association registry [24], less than 5% of HFrEF patients received device therapy, significantly lower than the European Registry [25].

Milder cases of HFrEF are not detected at an acceptable rate in the country. Data from a hospital HF registry in 2015 showed that 74.5% of patients had an EF < 40% [26]. The high prevalence of HFrEF is somewhat similar to that in a European registry (59.8%) and a Middle Eastern registry (69%) but notably higher than in an American registry (48.8%) [24, 25, 27].

Early intervention to delay the progression of HFrEF to more advanced stages is often limited to incidental cases. One contributing factor to the low rate of early detection and treatment planning for HFrEF is the lack of a functioning primary care physician network in Iran, a plan that failed in its pilot phase [28, 29]. This shortage hampers timely intervention and comprehensive care for HFrEF patients. Furthermore, the lack of awareness about HFrEF among the general population can contribute to delays in seeking medical care [30]. Many people do not recognize the signs and symptoms of HFrEF, often misinterpreting them as less serious conditions [31]. Accordingly, public health initiatives, alongside strengthening the primary healthcare network by addressing financial and resource challenges and increasing healthcare professionals, are crucial for improving early-stage HFrEF management.

Our study highlights the under-utilization of post-acute HFrEF patients. A considerable proportion of patients did not receive essential treatments, such as ACE inhibitors/ARBs and beta-blockers. The ESC-CHF guidelines recommend ACE inhibitors for HFrEF patients and the addition of beta-blockers in cases of asymptomatic left ventricular dysfunction [32]. Furthermore, international guidelines, including the 2022 AHA/ACC/HFSA Guideline for the Management of Heart Failure, emphasize the importance of conducting a clinical evaluation within

Table 4 CHF healthcare quality indicators

Category	Indicators	Female N(%)	Total No. of eligible patients	Male N(%)	Total No. of eligible patients	Both N(%)	Total No. of eligible patients
Inpatient	Administration of CPR and defibrillation due to cardiac arrest.	4 (5.3%)	75	13 (10.5%)	124	17.0 (8.5%)	199
	Echocardiography and measurement of EF	40 (90.9%)	44	73 (91.2%)	80	113.0 (91.1%)	124
	Echocardiography and measurement of EF(Follow-up).	8 (61.5%)	13	12 (57.1%)	21	20.0 (58.8%)	34
	CXR performing	34 (79.1%)	43	62 (81.6%)	76	96.0 (80.7%)	119
	CXR performing (Follow-up)	7 (50.0%)	14	15 (68.2%)	22	22.0 (61.1%)	36
	BNP level measurement	3 (9.4%)	32	9 (17.6%)	51	12.0 (14.5%)	83
	BNP level measurement (Follow-up)	4 (28.6%)	14	9 (42.9%)	21	13.0 (37.1%)	35
	Troponin level measurement	21 (63.6%)	33	31 (56.4%)	55	52.0 (59.1%)	88
	Troponin level measurement (Follow-up)	5 (41.7%)	12	11 (52.4%)	21	16.0 (48.5%)	33
	Cardiologist visit due to exacerbation of HFrEF symptoms	38 (88.4%)	43	76 (96.2%)	79	114.0 (93.4%)	122
	Cardiologist visit due to exacerbation of HFrEF symptoms (Follow-up).	7 (53.8%)	13	16 (76.2%)	21	23.0 (67.6%)	34
	Readmission to the hospital due to worsening HFrEF during the past year.	26 (32.9%)	79	42 (34.4%)	122	68.0 (33.8%)	201
	Readmission to the hospital due to worsening HFrEF during the past year (Follow-up).	6 (13.6%)	44	7 (9.1%)	77	13.0 (10.7%)	121
Medication	HFrEF	81 (97.6%)	83	121 (97.6%)	124	202.0 (97.6%)	207
	Hypertension	51 (98.1%)	52	54 (98.2%)	55	105.0 (98.1%)	107
	Diabetes Mellitus	31 (96.9%)	32	27 (81.8%)	33	58.0 (89.2%)	65
	CKD	10 (83.3%)	12	8 (66.7%)	12	18.0 (75.0%)	24
	COPD	17 (68.0%)	25	23 (59.0%)	39	40.0 (62.5%)	64
	Anemia	19 (63.3%)	30	10 (55.6%)	18	29.0 (60.4%)	48
	Prescription of an ACE Inhibitor or ARB for the patient with EF <40% at discharge.	27 (67.5%)	40	52 (67.5%)	77	79.0 (67.5%)	117
	Prescription of an ACE Inhibitor or ARB for the patient with EF <40% at discharge (Follow-up).	9 (75.0%)	12	16 (84.2%)	19	25.0 (80.6%)	31
	Prescription of the β-Blocker drugs for the patient with EF <40% at discharge.	35 (83.3%)	42	65 (86.7%)	75	100.0 (85.5%)	117
	Prescription of the β-Blocker drugs for the patient with EF <40% at discharge (Follow-up).	11 (84.6%)	13	19 (95.0%)	20	30.0 (90.9%)	33
	Prescription of one of the β-Blocker drugs in the past 12 months.	70 (86.4%)	81	102 (82.9%)	123	172.0 (84.3%)	204
	Prescription of one of the drugs in the ACE Inhibitor or ARB category in the past 12 months.	58 (71.6%)	81	86 (69.9%)	123	144.0 (70.6%)	204
	Prescription of an Aldosterone antagonist drug if EF<35% in the past 12 months.	49 (63.6%)	77	82 (68.3%)	120	131.0 (66.5%)	197
	Review of medication usage by the physician in the past year.	75 (92.6%)	81	119 (95.2%)	125	194.0 (94.2%)	206
	Review of medication usage by the physician in the past month (Follow-up)	40 (90.9%)	44	75 (97.4%)	77	115.0 (95.0%)	121
	Receiving appropriate medication instructions from healthcare providers in the last year.	73 (91.2%)	80	116 (92.8%)	125	189.0 (92.2%)	205

Table 4 (continued)

Category	Indicators	Female N(%)	Total No. of eligible patients	Male N(%)	Total No. of eligible patients	Both N(%)	Total No. of eligible patients
	Receiving appropriate medication instructions from healthcare providers in the past month (Follow-up).	31 (70.5%)	44	62 (80.5%)	77	93.0 (76.9%)	121
Ambulatory care	Physician examination for heart rate assessment through pulse or stethoscope in the past year.	75 (92.6%)	81	112 (89.6%)	125	187.0 (90.8%)	206
	Physician examination for heart rate assessment through pulse or stethoscope in the past month (Follow-up).	39 (88.6%)	44	70 (90.9%)	77	109.0 (90.1%)	121
	Physician examination for edema, fluid retention, and foot and ankle assessment in the past year.	49 (61.3%)	80	65 (52.8%)	123	114.0 (56.2%)	203
	Physician examination for edema, fluid retention, and foot and ankle assessment in the past month (Follow-up).	36 (81.8%)	44	66 (85.7%)	77	102.0 (84.3%)	121
	Review of requested tests in the previous visit by the physician in the past year.	66 (81.5%)	81	93 (75.0%)	124	159.0 (77.6%)	205
	Review of requested tests in the previous visit by the physician in the past month (Follow-up).	15 (62.5%)	24	23 (63.8%)	36	38.0 (63.3%)	60
	Reception of appropriate instructions on actions to take during worsening symptoms from healthcare providers in the past year.	51 (63.0%)	81	72 (57.6%)	125	123.0 (59.7%)	206
	Reception of appropriate instructions on actions to take during worsening symptoms from healthcare providers in the past month (Follow-up).	21 (47.7%)	44	34 (44.2%)	77	55.0 (45.5%)	121
	Arrangement for a cardiology visit within 7 days post-discharge from the hospital.	16 (64.0%)	25	32 (76.2%)	42	48.0 (71.6%)	67
	Arrangement for a cardiology visit within 7 days post-discharge from the hospital (Follow-up).	4 (66.7%)	6	6 (85.7%)	7	10.0 (76.9%)	13
	Telephone follow-up by a trained HFrEF nurse post-discharge from the hospital.	13 (28.9%)	45	24 (30.8%)	78	37.0 (30.1%)	123
	Telephone follow-up by a trained HFrEF nurse post-discharge from the hospital (Follow-up).	4 (30.8%)	13	2 (9.5%)	21	6.0 (17.6%)	34
	Echocardiography and measurement of EF performed within the last 12 months.	61 (76.2%)	80	96 (77.4%)	124	157.0 (77.0%)	204
	Referral to a physician or nutrition specialist for the treatment of malnutrition and excessive weight loss.	11 (47.8%)	23	3 (18.8%)	16	14.0 (35.9%)	39
Life style modification	Consultation by the physician regarding appropriate diet and salt restriction in the past year.	71 (87.7%)	81	110 (88.0%)	125	181.0 (87.9%)	206
	Consultation by the physician regarding appropriate diet and salt restriction in the past month (Follow-up).	39 (88.6%)	44	75 (97.4%)	77	114.0 (94.2%)	121
	Consult with healthcare providers regarding appropriate diet and salt restriction in the past year.	65 (81.2%)	80	108 (86.4%)	125	173.0 (84.4%)	205
	Consultation by healthcare providers regarding daily weight monitoring in the past year.	31 (38.8%)	80	35 (28.0%)	125	66.0 (32.2%)	205
	Consultation by healthcare providers regarding exercise and physical activity in the past year.	62 (76.5%)	81	98 (78.4%)	125	160.0 (77.7%)	206
	Consultation by healthcare providers regarding smoking cessation in the past year.	11 (57.9%)	19	42 (76.4%)	55	53.0 (71.6%)	74

All subsequent results are reported in person-month level data, Inpatient: During Hospitalization, *CPR* Cardiopulmonary Resuscitation, *EF* Ejection Fraction, *CXR* Chest X-ray, *BNP* B-Type Natriuretic Peptide, *CHF* Congestive Heart Failure, *ACE* Angiotensin Converting Enzyme, *ARB* Angiotensin Receptor Blocker, β-Blocker drugs:Including Metoprolol, Bisoprolol, Carvedilol, Ambulatory care:During a visit

7–14 days post-hospitalization to facilitate the transition to ambulatory care [33]. Enrolling patients in a multidisciplinary program is highly beneficial. According to a study in North America, 34% of HF patients received no follow-up visits, and only 49.67% attended their first medical visit after an average of 66.53 days post-discharge [34, 35]. Despite initial efforts to establish cardiac rehabilitation and home care [36, 37] in the country, the follow-up rate is meager due to the fragmented approach to HF outpatient care. Cintron et al. demonstrated that a

combination of regular follow-ups, education, and clinical support led to a 60% reduction in hospital readmissions and an 85% reduction in the length of stay [38]. Integrated HFrEF care, including the involvement of an experienced HFrEF cardiologist, has been shown to significantly reduce hospital readmissions, length of stay, and costs [39, 40].

The IQCAMP study found that outpatient care is the primary driver of healthcare costs for many chronic conditions and is mainly paid for by patients out-of-pocket (OOP). For example, HFrEF patients cover 21% of their care expenses, while for other diseases like diabetes, patients pay a much higher percentage of the total cost, at 78.15% [41]. The lower out-of-pocket burden for hospitalizations can be explained by the fact that these costs are more comprehensively covered by insurance. In contrast, while ambulatory services are utilized more frequently, they often involve substantial out-of-pocket expenses, particularly for medications, which are not always fully covered by insurance. As a result, patients bear a larger share of the cost for outpatient services and medications, which can create the impression that ambulatory care is more expensive, even though hospitalizations represent the larger overall financial burden when both insurance and patient contributions are considered.

Quality of HFrEF care

The readmission rate of 33.8% is much higher than the United State rate of 19.9%, which presents several challenges to HF care [42]. Disease management programs, such as medication adherence, diet, exercise, and symptom recognition, can reduce readmissions by up to two-thirds [43, 44]. Adherence to recommended maintenance therapies, such as prescribing beta blockers for these patients, is a crucial aspect of quality care. Data from Western countries shows a higher rate of beta-blocker prescriptions for HF patients: 89% in the United State [45] and 99.1% in Sweden [46]. Additionally, physician examinations for edema, fluid retention, and foot and ankle assessments conducted in the past year revealed that only 56.2% of patients received appropriate evaluations, highlighting shortcomings in the quality of care.

Our study revealed significant gender disparities in the utilization of healthcare services for heart failure with reduced ejection fraction (HFrEF), with men consistently receiving more comprehensive care than women, particularly in areas such as inpatient, outpatient, and pharmacy services. This pattern suggests potential barriers or inequalities in access to care, which we interpret as gender disparities. Specifically, males were found to utilize outpatient and pharmacy services more frequently than females, indicating differences in healthcare access or delivery between genders. These disparities have important implications for heart failure management in women, potentially contributing to suboptimal outcomes. Previous studies have demonstrated similar gender disparities in both the quantity and quality of care for HFrEF. For instance, one study found that women were less likely than men to receive guideline-recommended medical and interventional treatments [47]. Additionally, post-discharge adverse events were more common among low-income heart failure patients, a demographic more likely to include women, highlighting further socioeconomic and gender-based inequalities [48]. The evidence of male advantage in cardiology care underscores the necessity for targeted efforts to ensure equitable access to these services for all patients, vital for improving heart failure outcomes [49].

Improved HFrEF care is facilitated with a national plan and support from primary care physicians. Economic hardship has deprioritized disease-specific strategies, leading to insufficient preventive services and increased costs as HFrEF progresses, which places a more significant burden on HFrEF patients. In the Persian Gulf region, only a few countries have established specialized heart HF programs with trained staff, such as Saudi Arabia, where there are at least 10 HF clinics. The standard HFrEF treatment in some Middle Eastern countries, including ACE inhibitors, ARBs, beta-blockers, and aldosterone antagonists, is often supplemented with aspirin, statins, and diuretics, leading to improved patient outcomes. Expanding specialized HFrEF programs with trained nursing staff can reduce patient non-compliance and hospital readmissions, emphasizing the importance of prevention and risk factor control in the Middle East. Healthcare authorities should prioritize strategies to improve patient outcomes and access to care [24, 50].

This study offers significant value for the Iranian healthcare system by providing the first data on healthcare quality and resource utilization for patients with chronic HF with reduced EF. The findings can help policymakers and healthcare providers identify areas where resources are over- or under-utilized, leading to more efficient allocation of healthcare services. By analyzing real-world patterns of healthcare use, such as hospital admissions, outpatient visits, and medication prescriptions, the study provides insights into current practices that may benefit from optimization. Moreover, the study highlights potential gaps in care, such as underutilization of evidence-based therapies, which could inform future clinical guidelines and improve patient outcomes. These insights can ultimately contribute to better management strategies, reduce unnecessary costs, and enhance the overall quality of care for CHF patients in Iran, setting a foundation for more targeted and effective healthcare policies.

Despite the study's benefits, there were some limitations. While the data collection method enabled a

nationally representative sample, the small number of enrolled subjects prohibited subgroup and subnational analyses. Due to the lack of administrative claims data at the national level, the self-reports could not be benchmarked against the claims. However, the relatively short recall bias and partial benchmarking of the services for the cost of provided care partially offset this shortcoming.

Conclusions

HFrEF patients in Iran face challenges in receiving adequate, high-quality care. Economic difficulties have hindered the development of comprehensive care programs to enhance their treatment.

Abbreviations

HF	Heart failure
ACEI	Angiotensin-converting enzyme inhibitors
ARBs	Angiotensin receptor blockers
NCDs	Non-communicable diseases
IQCAMP	Iran quality of care in medicine program
QoC	Quality of care
LMIC	Low and middle-income countries
NQF	National quality forum
PPP	Purchasing power parity
OOP	Out of pocket
CRT	Cardiac resynchronization therapy
ICD	Intracardiac defibrillation
EF	Ejection fraction
HFrEF	Heart failure with reduced ejection fraction
ECG	Echocardiography
NIMAD	National institute for medical research development

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Authors' contributions

FG: acquisition, analysis, interpretation of data, drafted the work; MRN: conception, design of the work, interpretation of data, and revising the work; AM: conception, design of the work; SK: all, MRB: like AH, JH: like AH, MM: conception, design of the work, NSh: like MM; MA: design of the work, acquisition, analysis, YF: all, SSH: all.

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Availability of data and materials

The authors confirm that the data that support the findings of this study will be available upon reasonable request.

Declarations

Ethics approval and consent to participate

The IQCAMP Survey received approval from the ethics committee of the Iran National Institute for Medical Research Development (NIMAD) in Tehran, Iran (Ethics Code: IR.NIMAD.REC.1395.003).

Consent for publication

Not applicable.

Competing interests

The authors affirm that this research was conducted without any commercial or financial associations that could be interpreted as potential conflicts of interest.

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