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Research Article

Cost of Heart Failure In-Patient in Saudi Arabia: Role of Heart Failure Multidisciplinary Program

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Abstract

Background: Globally, the prevalence of heart failure (HF) is rising in many countries, same as in Saudi Arabia but the economic burden of direct and indirect costs for HF hospitalization and re-hospitalization are not well studied in Saudi Arabia. The aim of this study was to assess the efficiency of the newly established multidisciplinary HF team at King Saud University Medical City (KSUMC) in reducing the costs of each HF patient per year.

Material & Methods: A non-interventional retrospective prevalence-based single-center King Fahad Cardiac Centre (KFCC) study was conducted with all the HF in-patients from January 2014 to December 2019 at KSUMC.

Results: The study included a total of 943 patients, where 531 were male, a study period of 6 years. The mean age was 61.65 ± 1.9 year, the median length of stay (LOS) was 11.6 days (compared to the global average which is 4-5 days), BMI was 29.9, the median NT-proBNP was 6015.3 pg/ml and NYHA was 2.9. Hypertension (HTN), Diabetes (DM), dyslipidemia and coronary artery disease (CAD) were the most commonly reported comorbidities in the study period. As per the recent study for Middle East (ME) countries (Egypt, Saudi Arabia and UAE), the average cost per year per patient was 8137 $. The patient's admission and readmission cost, which were the direct costs, was the major cost driver ranging from 25% to 56% of total cost, therefore, the average admission cost was 30% of total cost. Hence the admission cost for each patient per year was 8137 $ x 30% = 2441 $. The readmission cost in 2014 was $ 90317 and in 2015 was $ 19528, which was represented a drop of 78.4%. In 2016, it was $ 17087 showing a drop of 81%. In 2017, it was 86.5% and 83.9% respectively in 2018 and 2019. The indirect medical costs were estimated based on a human capital approach.

Conclusions: Our HF program has a role to keep up the positive outcomes by reducing the HF readmission, hence reduce the direct and indirect costs. We were able to reduce the re-hospitalization for NYHA Class-2 by managing in outpatient clinics and therefore reducing the total cost of HF per year. We can improve the research quality by adding higher numbers of patients with more geographical representation and estimation of other costs, such as indirect costs may be needed in future studies.

Keywords: heart failure outcome; troponin leak; ICD therapy; ICD shocks

Introduction

Heart failure (HF) is a clinical syndrome with symptoms and/or signs caused by a structural and/or functional cardiac abnormality and supported by elevated natriuretic peptide levels and/or objective evidence of pulmonary or systemic congestion [1]. HF is a global health problem that is associated with poor quality of life and an ever-rising healthcare cost ($24,383 per patient) [2]. Primary goals of HF therapy are to slow down progression of symptoms, improve patient's quality of life, prolong survival, and decrease cost [3].

The New York Heart Association (NYHA) functional classification by far, is the most used classification system which places heart failure patients in one of four categories based on how much they are limited during physical activity [4].

Despite these goals, morbidity and mortality remain high in managing heart failure [5, 6]. It accounts for 5% admission in industrialized countries. It has a high re-hospitalization rate, and the long-term mortality is high compared to some major cancers [7]. A recent registry in Europe revealed that patients hospitalized with HF have generally worse outcomes than ambulatory patients with chronic HF [8]. HF affects more than 64 million individuals world-wide and the prevalence among adults in developed countries was reported to be approximately 4.2%, with 11.8% of individuals aged 65 years or above [9-11].

HF is a leading cause of death, with approximately 42.3% of patients dying within 5 years of their diagnosis [12]. It also has a significant impact on patients' physical and mental health, leading to a deterioration in their quality of life [13]. Poor quality of life (QoL) is a strong and independent predictor of mortality and HF hospitalizations in all regions represented in Global Congestive Heart Failure (G-CHF) registry, in mildly and severe symptomatic HF, and among patients with preserved and reduced ejection fraction (EF) [14].

HF poses a considerable financial strain on several nations' healthcare systems and society [15]. In Saudi Arabia, the estimated number of patients diagnosed with HF was 455,222 in 2012, with approximately 32,200 new patients being projected to be diagnosed annually [16]. The mean age of patients diagnosed with chronic and acute HF ranged between 57 and 60 years, which is lower than that of many developed countries [17, 18]. Globally, the total annual cost of treating HF patients was estimated at $108 billion, approximately 60% of which was related to direct medical costs [19, 20]. (Direct medical cost is related to patient care like hospitalization, medications, lab tests, diagnostic tests, outpatient visits, patient counselling etc and indirect costs refers to those costs incurred not as a result of medical management of the disease but rather of other incurred losses such as lost wages, lost productivity, and costs resulting from the need for home care and child care that would otherwise not be incurred) [21, 22]. A new practice has taken place at King Saud University Medical City (KSUMC)which is the heart failure program that consists of cardiology consultant, clinical pharmacist, nurse specialist, health educator and also constructed the HF key performance indicator (KPI) (checklists, Saudi Heart Association (SHA) HF hospital guidelines [23] (clinical practice guideline which is adapted from American Heart Association(AHA) [24] and National Institute for Health & Care Excellence (NICE) guideline [25] according to Appraisal of Guidelines for Research & Evaluation Instrument AGREE II tools) and a data base for HF patients in hospital were built up as well as established a location for the clinics to monitor the discharged patients closely. A recent study about cost of illness (COI) in Saudi Arabia showed the direct medical cost per HF patient was $9563 [15]. The overall cost of treating HF patients in the United States of America (USA) was $43 billion in 2020 and is anticipated to rise $69.7 billion by 2030. In other countries, the total cost was $6.8 billion in Brazil, $752.8 million in South Korea, and $103.6 million in Lebanon, with HF treatment accounting for around 2% of both the United Kingdom (UK) and Sweden's healthcare budgets. The total estimated cost in Middle East (ME) countries like Egypt was $0.356 billion, in Saudi Arabia was $1.045 billion and in UAE was $0.519 billion. Whereas annual per-patient costs were the highest in UAE followed by SA and EG (US $13,836; $8,137; $850, respectively) [26-32].

The primary objectives of this study are to improve management of HF, utilize the manpower and decrease the cost of management and reutilize resources to improve QoL and to establish a program or standard of care that will help to improve HF patient care with cost effective services. The endpoints of this study were the patient demographics, patient clinical characteristics, and health care resources used in the normal, routine care of HF patients.

In Saudi Arabia, HF hospitalization places a significant economic burden on pharmacies, laboratories, healthcare workers, hospital resources, and etc. Our goal was to estimate the annual direct cost of HF treatment by reducing the number of re-hospitalizations, taking into account the estimated costs for hospitalized HF patients at KSUMC (King Saud University Medical city) over a 5-year period (2015-2020).

2. Material & Methods:

2.1 Design and Population:

We conducted a non-interventional retrospective prevalence-based single-centre study at KSUMC to assess the effectiveness of creating multidisciplinary team based (certified HF cardiologists, qualified HF nurses, clinical cardiac pharmacists, dietitians, and health educators) HF program for patients with HF in January 2015 at King Fahd Cardiac Centre (KFCC) Riyadh, Saudi Arabia under the umbrella of KSUMC. This HF program was involved in both outpatient services as well as inpatient. Our study was for the inpatient cost of care. The study population was from January 2014 to December 2019.This was assisted by establishing a HF database, which reflects the comparison of the annual cost of each HF hospitalized patient before and after the initiation of the program. Based on the latest HF guidelines, the diagnosis of heart failure and the standard variables definitions were in accordance with the European Society of Cardiology key data elements and definitions for measuring the clinical management and outcomes of patients with heart failure [33, 34]. The cost was compared with a public sector perspective (e.g Ministry of Health). We obtained the Saudi Arabian GDP per capita for the year 2020 from the World Bank database and used it as an index for evaluating indirect costs [35]. The total cost was calculated in US dollars (1 USD= 3.75 Saudi riyals).

Direct costs for our study were involved with general physician and specialist physician services, non-physician personnel services, emergency services, hospitalization without surgical services (acute and chronic diseases), day clinic services, diagnostic services (including laboratory, imaging and genetic counseling clinic), health services as non-official person (who are ineligible approved by the Ministry of Health) and the indirect costs covered patient transportation expenses to receive health services along with the family, patient and the family housing costs (other than admission), expenses related to the patient's temporary and permanent disability due to illness, for the foods, communication technologies (telephone, Internet, etc.) and related to the patient's changing jobs were estimated based on human capital approach for Saudi Arabia.[36]

2.2 Data Collection:

Secondary data of all patients included in this study were collected by constructing a paper-based case record form (CRF) which were extracted using our Electronic Medical Records (EMR) for all consecutive KSUMC hospitalized acute on top of chronic and de novo (newly diagnosed) HF patients aged more than 18 years for a study period of 6 years (2014-2019), to capture the entire spectrum of medical care for heart failure patients. [37] As per the inclusion criteria, we filtered the eligible patients' Medical Record Numbers (MRN) after getting the Institutional Review Board (IRB) approval and completed the designated CRF of the study. It is a retrospective, prevalence-based, observational single-centre study and the study proposal was gone through expedited review by the Ethical Committee of KSUMC (IRB # E-16 1981).

The following information were captured for each patient in this study:

2.2.1 Demographics: age in years, gender, duration of admissions and readmission.

2.2.3 Direct Cost: We have used the information from our recent study from KSUMC in 2018, for the total cost of each HF hospitalized patient and then calculated the direct cost which were general physician and specialist physician services, non-physician personnel services, emergency services, hospitalization without surgical services (acute and chronic diseases), day clinic services, diagnostic services (including laboratory, imaging and genetic counseling clinic) for all HF re-hospitalized patients before and after the establishment of the HF program. Then we have compared each HF hospitalized patient's direct cost per year for the period of 5 years from 2014 [32].

2.2.4 Checklist for the cost calculation: The checklist was developed based on recommendations of the HF guidelines and included the use of angiotensin-converting enzyme inhibitors (ACEIs) or angiotensin receptor blockers (ARBs), ß-blockers, and influenza and pneumococcal immunizations [38]. It also had a section for education, including medications, which was carried specifically by the clinical pharmacist. We assessed the effect of the checklist on adherence to such a regimen in terms of 30-day readmission rates.

2.3 Statistical Methods and Data Analysis: We performed descriptive statistics, including the calculation of means, standard (SD), and frequencies. Additionally, we used inferential statistics as needed, including t-test and the analysis of variance (ANOVA) tests to compare the cost of HF groups. We also performed a Linear regression analysis to analyze the association between the estimated costs and different variables, such as age, gender, EF, and comorbidities. All p-values less than 0.05 were considered statistically significant. We conducted statistical analyses using the Statistical Package for the Social Sciences (SPSS) version 23 (SPSS Inc., Chicago, IL, USA).

3. Results:

The study included a total of 943 patients covering the period from January 2014 to December 2019. The total number of male patients was 531 as well as total number of female was 412 for the entire study period of 6 years. The mean age was 61.65 ± 1.9 years, and the average length of stay (LOS) was 11.6 days (compared to Global average which is 4-5 days). The average BMI was 29.9. The age group, LOS and BMI has been near about constant throughout these 5 years.

The table 1 showed that, Hypertension (HTN), Diabetes (DM), Dyslipidaemia and Coronary Artery Disease (CAD) were the most reported comorbidities in the study period. We were unable to collect some variables retrospectively for 2014, before the built up of HF program. Through the HF program, we were able to capture hypothyroidism, anaemia, coronary artery diseases (CAD) and DM: Diabetes Mellites, dyslipidaemia accurately, which were managed by the efficient teamwork in the program and eventually the re-admission was reduced for these associated comorbidities, shown in table 1. As per the NYHA classification, average class was 2.9. In 2014 and 2015, the patients were admitted and re-admitted with average NYHA class 2.3, but after the fully establishment of the program, we were able to manage such group in the outpatient clinic.

Years	2014	2015	2016	2017	2018	2019	Average
Diabetes Mellites (DM)	127	105	160	186	143	107	138.0
Hypertension (HTN)	118	108	171	205	172	119	148.8
STROKE	2	5	21	25	15	10	13.0
HYPOTHYRIODISM	no data	15	17	32	27	18	21.8
ANAEMIA	no data	30	124	142	120	76	98.4
Chronic Obstructive Pulmonary Disease (COPD)	23	9	42	44	24	27	28.2
Coronary Artery Disease (CAD)	72	105	140	153	126	74	111.7
DYSLIPIDAEMIA	98	93	163	194	168	111	137.8
MORBID OBESITY	98	49	103	132	74	59	85.8
New York Heart Association (NYHA) CLASS	2.5	2.1	3.1	3.1	3.3	3.1	2.9

Abbreviation: DM: Diabetes Mellites, HTN: Hypertension, COPD: Chronic Obstructive Pulmonary Disease, CAD: Coronary Artery Disease,

Table 1: Patient's disease characteristics.

As per the recent study for Middle East (ME) countries i.e., Egypt, Saudi Arabia and UAE, the average cost per year per patient was 8137 $. The patient's admission and readmission cost, which is the direct cost, is the major cost driver ranging from 25% to 56% of total cost, therefore, the average admission cost was 30% of total cost. Hence the admission cost for each patient per year was 8137 $ x 30% = 2441 $.

Figure 1 below demonstrates that for the readmission of 37 patients in 2014, the total cost was $ 90317 using the Middle East and North America (MENA) cost and for 8 readmissions in 2015, total cost was $ 19528, representing a drop of 78.4%. In 2016, for 7 readmissions, the total cost was $ 17087 showing a drop of 81%. In 2017, it was 86.5% for 5 readmissions despite having the highest average comorbidities but lowest number of readmissions, in comparison of other years in our study. Finally, there was 6 readmissions with the total cost of $ 14646, representing a drop of 83.9%, maintained for 2018 and 2019 successively.

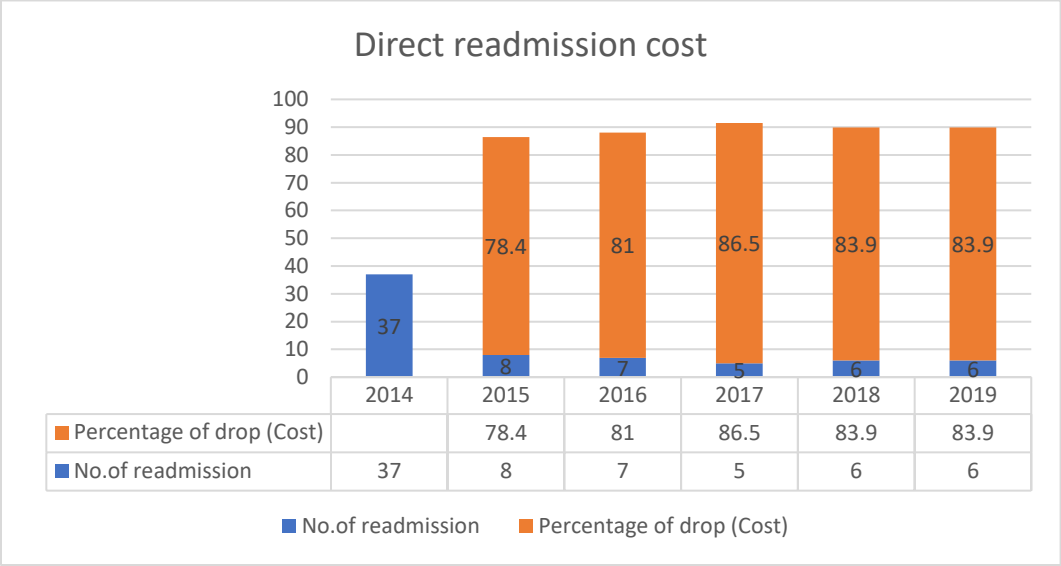

Figure 1: Direct readmission cost.

Table 2 shown the laboratory values for our study period. The average values of all the parameters were constant throughout the journey of our study, but we were able reduce the readmission of the HF patients. This represents a steady outcome after the establishment of the multidisciplinary team.

Years	2014	2015	2016	2017	2018	2019	Average
Hb	12	12.6	11.9	11.8	12	12.1	12.1
FERRITIN	347.2	187.2	191.9	202.7	202.7	187.4	219.9
URIC ACID	458.7	515.5	482.9	487.9	514.1	491.5	491.8
TSH	4.8	4.8	3.6	4.1	4.9	2.8	4.2
T4 FREE	16.6	16.9	17.3	16.8	17.2	16.7	16.9
PRO-BNP	5943.3	6182.9	6384.7	5742.3	6486.5	5352.3	6015.3
Na +	133	133.1	133.5	135.6	135.5	135.9	134.4
K+	4.8	4.2	4.2	4.2	5.7	5.1	4.7
UREA	13.9	12	13.6	15.2	17.9	17.6	15.0
CREATININE	52	126	140.2	141.2	157.9	156.6	129.0
Mg+	no data	1.3	0.8	0.9	0.9	0.9	1.0
SBP	no data	113.9	110.6	111.4	110.9	113.7	112.1
DBP	no data	65.5	62.3	62.7	62.6	64	63.4
HR	no data	76.4	75	76.3	73.9	78.8	76.1

Table 2: Laboratory findings.

4. Discussion

The estimation of the economic impact of HF on society is a great tool that provides valuable information about the use of health resources and the country's expenditure on this disease. This will help decision makers in prioritizing healthcare policies, implementing interventions, and efficiently allocating the available health resources [38, 39].

Inpatient HF expenditure was subdivided for direct and indirect medical costs.

We aimed to develop an efficient multidisciplinary team to improve the quality of life for HF patients which eventually will increase the cost-effectiveness in heart failure. Outcome of the HF improved by adherence to the guideline-directed medical therapy (GDMT). The GDMT is for heart failure with reduced ejection fraction (HFrEF) and is recommended prior to primary prevention implantable cardiac defibrillator (ICD) placement [40]. The GDMT as shown in the appendages, were invented by our hard-working team. We had created our own HF assessment checklists to assess accurately and properly by the physicians and nurse's specialist, titrating of medications by experienced clinical pharmacist through the medication checklist and introducing seasonal jabs checklist, echo instruction, smoking cessation counseling and dietary counseling in three separate checklists for adjusting the outcome, checklists were a helpful tool for gathering the information needed for KSUMC heart failure patients data. . We had constructed a walk-in clinic for closely monitoring patients within 2-3 weeks of discharging from the outpatient clinic.

In 2017, the patient numbers increased with all the comorbidities but by strictly adhering to our own GDMT through the efficient HF program, we were able to maintain homogenous stability.

The role of the HF Consultant from this multidisciplinary team was, to diagnose the patient and carefully evaluate the patient's symptoms, be alert and ask for common verbal descriptors of NYHA by using his experience to classify which class of the patient fits, assess Jugular venous pressure (JVP), echocardiogram, laboratory work (for example; Brain Natriuretic Peptide (BNP) and label the patient as HF with NYHA classification.

The HF Clinical Pharmacist from the team played the most important role in both aspects of pharmacological and non-pharmacological management. They ensured the initiation of ACEI/ ARBs, BBs, and others to all HF patients and achieved the targeted therapy dose. They gave proper education and counseling about contraindications, intolerance, or other reasons to HF team in collaboration with the patients and caregivers for not utilizing proper therapies [41]. They prevent, detect, and resolves medication-related

problems and provide comprehensive, and timely responses to drug information requests as well as they document the source of scientifically valid information and advice regarding the safe, appropriate, and cost-effective use of medicines and develop, review, and evaluates clinical guidelines for medications used in stated management protocol with GDMTs according to evidence, compliance with prescription during hospitalization and delivery of adequate patient education regarding medication use and follow-up, thereby improving the outcome of patients with HF [42,43].

During the transition of patients from the setting of inpatient to outpatient and being assessed by different caregivers, pharmacists play a positive role by influencing medical reconciliation and patients' education, which will result in assuring consistency in management and reducing medication errors. Utilizing GDMT, this will decrease emergency department visits, hospitalizations for HF, and all-cause readmissions for patients with HF. We were able to evaluate patients' adherence to medications by controlling polypharmacy problems in chronically ill patients and appointments throughout the program [44-46].

The nurses play an important role by establishing a link between the patient and the multidisciplinary team for optimal care. They educate patients on the meaning of HF and provide several strategic plans and counseling. They ensure that the patients are closely following their discharge instructions and emphasize adhering to GDMT while also focusing on timely follow up. Having nurse specialists in the multidisciplinary team increases the proper use of evidence-based HF therapies [47-48].

Figure 2 shows the KPIs checklists, for example, discharge patient on ACEi or ARB /Angiotensin receptor neprilysin inhibitor, discharge patient on beta blockers, as well as instructions upon discharge, etc. [49-50-51].

جامعة الملك سعود
King Saud University

Name: .....
Nationality: .....
Patient No. : .....
Sex : ..... D.O.B. : .....

Physician Assessment – Heart Failure Clinic
ACS-KFCC-01

Background History:

☐ DM ☐ HTN
☐ Atrial Fibrillation
☐ Persistent ☐ Paroxysmal
☐ IHD
☐ PCI ☐ CABG ☐ Medical Therapy
☐ ICD ☐ CRTD ☐ PPM
☐ Thyroid: ☐ Hypothyroid ☐ Hyperthyroid ☐ Thyroidectomy
☐ CKD: Baseline Creatinine .....
☐ Anemia ☐ OSA ☐ COPD
☐ Others: .....

Etiology of Heart Failure

☐ Ischemic
☐ Non-Ischemic
☐ DCM ☐ Alcohol ☐ Drug Abuse ☐ Restrictive
☐ Chemotherapy ☐ Peripartum ☐ Familial ☐ HOCM
☐ Others: .....

ECHO

☐ LV Function .....
☐ RV Function .....
☐ PAP .....
☐ Others: .....

ECG

☐ Sinus ☐ Atrial Fibrillation
☐ LBBB
☐ RBBB/Non specific IVCD
☐ QRSD .....

History:

NYHA Class:
☐ I ☐ II ☐ III ☐ IV
☐ Orthopnea
☐ PND
☐ Others: .....

Physical Examination:

BP: ..... HR: ..... Wt.: .....
JVP ☐ Raised ☐ Not Raised ..... cmH_2O
Chest ..... CVS .....
LL Edema ..... Others: .....

Plan

☐ Medication Adjustment
☐ Need to repeat ECHO
☐ Anticoagulation for Atrial Fibrillation
☐ Immunization:
☐ Influenza Vaccine Date .....
☐ Pneumococcal Vaccine Date .....
☐ Assess for ICD / CRTD
☐ Follow up after .....
☐ Health Education (smoking, diet, weight)

Laboratory

☐ ProBNP .....
☐ Urea .....
☐ Crea .....
☐ Na .....
☐ K .....
☐ Hb .....
☐ TSH .....
☐ IRON .....
☐ Ferritin .....
☐ Uric Acid .....
☐ Cholestrol .....
☐ Others .....

Medication

(Titrate to target dose)

	Name	Dose
ACEI		
ARB		
BB		
MRA		
Lasix		
Others:		

	Name	Signature	Computer Number	Date and Time
Physician				

March 2015

جامعة الملك سعود
King Saud University

Name: .....
Nationality: .....
Patient No. : .....
Sex : ..... D.O.B. : .....

Heart Failure Clinic Referral

AD-KFCC-03

Patient Telephone Number: .....

☐ **Urgent (within 2 weeks)** ☐ **Schedule (within 8 weeks)**

Reason for Referral (tick one or more)

- ☐ Persistent symptoms (NYHA class II-IV)
- ☐ Multiple readmissions with HF; 3x/ yr or (2x/ 6 month)
- ☐ Renal insufficiency; creatinine >150 mmol/L
- ☐ Evidence of low output state e.g. narrow pulse pressure, postural hypotension, intolerance to ACEI/BB due to hypotension or worsening kidney function, hyponatremia without hypervolemia.
- ☐ Persistent non-adherence to therapeutic regimens.
- ☐ Specific Cardiomyopathies e.g. familial DCM, RCM, HCM, PPCM, noncompaction, ARVD.
- ☐ Severe Pulmonary hypertension.

EF ..... % Date performed: ..... Comments: .....

Creat: ..... mmol/L K+: ..... mmol/L Na+: ..... mEq/L

We require the following information to process this referral:	Exclusion criteria:	The following patients would be considered for discharge from the heart failure clinic:
1) Completed referral form. 2) Cardiac history (i.e.Hospital admission note and discharge \summary). 3) Most recent ECG. 4) lab work s within 2 weeks (CBC, Renal profile, Pro-BNP) 5) Leftventricular function assessed within the past 6 months6) Medications	- Evidence of ischemia suitable for revascularization - Surgical valve disease suitable for surgical intervention.	1. Asymptomatic for at least one year of follow up. 2. Recovered LV function (for those with HFrEF) for at least one year of follow up.

	Name	Signature	Computer Number	Date and Time
Completed By				
Accepted By				

February 2015

Figure 2: Heart Failure checklist

5. Strength and Limitations:

This study aimed to estimate the cost of HF treatment for the hospitalized patients using real world data. However, the study has some limitations. The study is limited to the tertiary care center which might be more enthusiastic about adhering to guidelines and evidence-based practice and this may explain the high prescription rate of medication at baseline. There is also limited geographic representation compared with other countries. The observational nature of the study with the inherent selection bias was another weakness. Observational studies are especially prone to its many forms,

mainly due to the investigator's lack of control over the study. Selection bias may result when a study fails to select a representative sample from the population of interest, limiting the applicability of the study's results. In the estimation of direct costs, the study focused on direct medical costs and did not include indirect costs, such as that of transportation and housing for patients visiting from outside Riyadh. Although the study represents a large public healthcare institution in Riyadh, it does not account for those in other large institutions at a national level and from the private sector. Due to pandemic crisis caused by Covid-19, data was collected for 2020 but due to high emergency extensive care from intensive care Unit (ICU) admission and use of the resources unexpectedly, was not included to contaminate the data.

6. Conclusion:

Our program has a role to keep up the positive outcomes by reducing the HF readmission, hence reduce the direct and indirect cost. We were able to do reduce the re-hospitalization for NYHA class II by managing the group in outpatient clinics and therefore reducing the total cost of HF per year after establishing and succeeding the goal of HF program.

We can improve the research quality by adding higher numbers of patients with more geographical representation and estimation of other costs, such as indirect costs may be needed in future studies.

Funding: This research received no external funding.

Institutional Review Board Statement: This study was approved by the Institutional Review Board (IRB) Committees at KSUMC (IRB # E-16 1981).

Informed Consent Statement: Informed consent was not obtained from the subjects as per the IRB protocol of the retrospective observational study.

Data Availability Statement: Data sharing not applicable.

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Conflicts of Interest: The authors declare no conflict of interest.

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