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## Prevention of Heart Failure

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Oleksii Korzh

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### Abstract

Heart failure is a life-threatening disease, and its solution should be seen as a global health priority. Heart failure is indeed a complex disease and has until now been the leading cause of morbidity and mortality in developing and developed countries. Standardized medical therapy was successful in the early stages of heart failure. The advanced stages of heart failure require frequent hospitalization because of the presence of severe heart failure and/or associated comorbid conditions that require the strict implementation of an adequately individualized multidisciplinary approach and quality measures. Even after the development of heart failure, premature deaths can be prevented if they are taught to recognize symptoms and seek immediate medical attention. Public awareness campaigns on these messages have a great potential for improving outcomes for patients with heart failure and, ultimately, for saving lives. It is also quite possible that the prevention of cardiovascular diseases (CVD) in the adult population of the current generation to some extent is only a delay of events or a reduction in mortality from the case, rather than complete prevention. Preventing premature death from cardiovascular disease and years of life adjusted for disability is large but may be due to an increase in the prevalence of cardiovascular disease in the elderly and in very old cases with an epidemic of cardiovascular diseases in the terminal stage, such as chronic heart failure, renal insufficiency, and vascular dementia with all its consequences in terms of greater need for care than for treatment and increased costs of sanitation protection. Continuing research is needed if we want to solve the unmet need for care for patients with heart failure. New methods of treatment are needed for patients with types of heart failure, for which modern treatments ease the symptoms, but do not affect the disease. In the economically developing world, more accessible methods of treatment are desperately needed. International collaborative research on the causes and methods of treating heart failure around the world can benefit tens of millions of people. Compliance with the recommendations of clinical practice is also associated with improved results for patients with heart failure. However, there are significant differences in how closely the doctors follow the recommendations. In order to promote equitable care, improvements should be promoted through the use of indicators and incentives for hospitals that are appropriate to local conditions. To this end, the policy should facilitate the research needed to create an evidence base for performance indicators that reflect improved outcomes for patients.

**Keywords:** heart failure, prevention, compliance, medical care, lifestyle behaviors

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## 1. Introduction

Cardiovascular disease (CVD) remains the leading cause of death, premature mortality, and disability worldwide. The mortality rate from CVD has been declining since the early 1990s as a result of significant changes in lifestyle and improved health care. This growing prevalence is due to improved survival of people with myocardial infarction and patients with heart failure and a high burden of heart risk factors for people such as hypertension, obesity, diabetes, and smoking. While physical activity and regular exercise are emphasized for the development of general cardiovascular health, modern guidelines for heart failure inadequately emphasized the importance and recommendations for physical activity as a means of preventing a condition [1–3].

Nevertheless, there are certain regions with significantly higher total and mortality from cardiovascular diseases, despite relatively good access to medical care and invasive cardiology procedures. Previous reports conducted among residents of these regions showed adverse lifestyles with a very low prevalence of people who follow current recommendations for the prevention of cardiovascular diseases. This poor adherence to recommended recommendations may be a function of a lack of awareness of the methods of preventing CVD. Several studies have indicated that improving awareness of the risk factors for cardiovascular disease and prevention can be a prerequisite for adopting of a healthy lifestyle [2–5].

To determine the most effective ways to solve the problem of heart failure in different parts of the world, an international approach is needed, as well as the inclusion of necessary measures in everyday practice. Political initiatives at the local, national, and international levels can reduce mortality due to heart failure and improve the quality of life of patients.

## 2. The global burden of heart failure

In recent years, the survival rates of patients with heart failure have improved in many parts of the world, in parallel with the introduction of modern evidence-based methods and patient management systems. Nevertheless, about 2–17% of those admitted to the hospital with heart failure die in the hospital. Survival rates are better for those who are treated in outpatient clinics, which usually have less pronounced symptoms than those who are treated in the hospital. However, even the newest therapies can only alleviate the symptoms in many patients without slowing the progression of their disease or prolonging life. This is due to the fact that heart failure can arise due to a number of different underlying problems with the structure or function of the heart, some of which are more difficult to treat than others [3, 4].

HF may seriously damage developing countries by creating loss of productivity of cardiac patients. It often severely limits a person's ability to work. Loss of productivity hurts not only

the individual but affects the family's income and the country itself by extension. Also, the weakened cardiac patients often need caregivers; consequently, a caregiver often is a family member, and he or she has to stop working in order to nurse a cardiac patient at home. To treat HF and maintain good health in cardiac patients, it is necessary to prescribe several medicines that can be difficult to afford for some people [5–7].

Unfortunately, globalization creates unforeseen problems for most low- and middle-income countries. Adaptation of the western way of life and malnutrition of developed countries are spreading around the world. Limited financial resources and the weak structure of health systems in developing countries pose a barrier to managing the impending global epidemic of chronic diseases. The need to adapt evidence-based treatment plans and model approaches to public health from successful experiences of other countries should become urgent priorities for low- and middle-income countries [8].

Infections remain a common cause of heart failure in many parts of the world and can affect any age. Heart failure is not a disease of the elderly in sub-Saharan Africa, where half of the patients hospitalized with this disease are 55 years or younger. Patients in the Asia-Pacific region are also usually younger than in the western regions. Rheumatic fever due to preventable bacterial infections is an important cause of heart failure in Africa, Asia, Australia, and Latin America. HIV infection is also a major source of cardiovascular disease worldwide. In areas of Latin America where Chagas disease is prevalent, almost half of all cases of heart failure are the direct result of this preventable parasitic infection [9–11].

Heart failure is a widely researched disease because of its burden. There are many studies in which the incidence of heart failure is positively associated with several risk factors. The very first study that addressed the etiology of this disease was a cohort study that followed people for 20 years, a study of the heart of Framingham in the 1970s. According to the Framingham Heart Study, heart failure had several major risk factors. It was found that the highest risk factor for heart failure among the population is hypertension, which accounts for 39% of heart failure in men and 59% in women. The second most significant risk factor was myocardial infarction, which accounts for 34% of heart failure in men and 13% in women. Other important risk factors were diabetes mellitus, left ventricular hypertrophy, and heart valve disease. This was the first scientific evidence of heart failure associated with behavioral factors [12–14].

It has been proven that reducing risk factors will eventually reduce the likelihood of developing heart failure. Most cases of heart failure (90%) are explained by risk factors, such as diabetes, obesity, smoking, blood pressure, and high cholesterol. By reducing BMI, stopping smoking, keeping low cholesterol and blood pressure, and avoiding the other mentioned risk factors, people can potentially be protected from heart failure, cardiovascular diseases, and other chronic diseases. Knowledge of risk factors is very important for the prevention of HF, but they can also be used to combat heart failure and cardiovascular diseases [11, 13–15].

Heart failure significantly affects the quality of life of patients. Fear, anxiety, and depression are common, and work, travel, and everyday social and leisure activities are difficult for people with shortness of breath and extreme fatigue. Emotional, physical, and financial costs are also high for those who care for family members with heart failure. Heart failure leads to a large number of deaths and a widespread disease and requires huge economic and social

costs, and the problem worsens. It is time for coordinated awareness programs about heart failure and strategic and policy initiatives to improve patient care.

### 3. Preventing heart failure in high-risk groups

Prevention of heart failure is of paramount importance. After an establishment the deterioration of a status of the heart can be often treated, but as a rule, it is impossible to cancel. Policymakers should emphasize the need for health professionals in all clinical disciplines to identify patients with diseases that increase the risk of heart failure and prescribe preventive drugs. Ensuring access to preventive drugs should be provided to those who are at greatest risk for developing heart failure, regardless of age, sex, or income. Policymakers should also give priority to the elimination of certain infectious diseases in some parts of the world where they continue to cause heart failure [4, 8, 10].

Risk factors for heart failure vary from lifestyle factors to concomitant diseases, medications, laboratory, and visual characteristics for new biomarkers and genomic markers. The risk of heart failure increases with age, and the male sex is associated with a higher risk. Higher physical activity, increased salt intake, and lower socioeconomic status were associated with increased risk. Hypertension, diabetes, obesity, and coronary disease all increase the risk. More than half of patients hospitalized with heart failure, regardless of the ejection fraction, have coronary artery disease. Hypertension and coronary artery disease are the most common and most powerful risk factors, which bring an increased risk of two to three times. Valvular heart disease increases the risk due to hemodynamic changes.

Obesity, due to a variety of mechanisms, predisposes to heart failure. The excessive use of alcohol increases blood pressure and is a direct myocardial toxin; however, light consumption is moderately associated with risk, especially in men. Smoking contributes to several cardiovascular risk factors associated with heart failure. Dyslipidemia and renal dysfunction predispose to heart failure. Other comorbidities that increase the risk include anemia, sleep breathing disorder, increased heart rate, lung dysfunction, and microalbuminuria. The levels of homocysteine and natriuretic peptide are associated with an increased risk. Serum resistance, lipoproteins associated with phospholipase A2, and myeloperoxidase are also associated with an increased risk [9–12].

Most patients are fragile and elderly with concomitant diseases (e.g., concomitant respiratory diseases and renal dysfunction) that can limit and/or complicate treatment. Although formal classification systems have been developed, the most practical indicator of an increased risk of premature morbidity and mortality or reentering the hospital is the presence of two or more of the following:

- Age  $\geq$  65 years
- NYHA class III or class IV symptoms
- Charlson Index of Comorbidity Score of 2 or more

- Left ventricular ejection fraction (LVEF)  $\leq 30\%$
- Living alone or remote from specialist cardiac services
- Depression
- Language barrier (e.g., non-English speaking)
- Lower socioeconomic status (due to poorer compliance, reduced understanding of reasons for medicines, fewer visits to medical practitioners, high-salt diet in “take-away foods,” reduced ability to afford medicines, higher rates of cigarette smoking, etc.)
- Significant renal dysfunction (glomerular filtration rate  $< 60$  mL/min/1.73 m)

Several chemotherapeutic agents, for example, doxorubicin, cyclophosphamide, trastuzumab, and 5-fluorouracil, are associated with heart failure. Inhibitors of cyclooxygenase-2 may increase the risk of myocardial infarction. Thiazolidinediones were associated with edema and heart failure. Several cardiac anatomical and physiological measures are associated with a higher risk, including enlargement of the chamber with an increase in terminal diastolic or terminal systolic dimensions, an increase in left ventricular mass, worsening diastolic filling of the left ventricle, an increase in the left atrium, and asymptomatic systolic dysfunction. There is growing interest in genomic predictors of heart failure.

While patients at high risk benefit greatly from proper and consistent treatment, unfortunately, they often undergo suboptimal management. Their inability to tolerate even minor fluctuations in cardiac and renal function makes them vulnerable to frequent and recurring episodes of acute heart failure.

It is now recognized that up to two-thirds of hospitalizations associated with CHF can be prevented. The following variables are most often associated with poor health outcomes, especially in high-risk patients:

- Inadequate/inappropriate medical or surgical treatment
- Adverse effects of prescribed therapy
- Inadequate knowledge of the underlying illness and prescribed therapy
- Inadequate response to, or recognition of, acute episodes of clinical deterioration
- Nonadherence to prescribed pharmacological treatment
- Lack of motivation/inability to adhere to a non-pharmacological therapy
- Problems with caregivers or extended care facilities
- Inadequate social support

This is especially important for groups at high risk of developing this condition. Many people have diseases that put them at risk of heart failure. Health-care professionals who treat such patients should adopt a broad approach that includes encouraging positive lifestyle changes

that reduce the risk of heart failure and prescribe preventive therapy as needed. Medications that control blood pressure, heart rate, and cholesterol levels are effective in preventing heart failure in a large number of people who have conditions such as high blood pressure, coronary heart disease, kidney disease, and diabetes. Pacemakers and the replacement of heart valves can also prevent heart failure in a small number of people who have a particular heart rate or valve disorders. The range of diseases that predispose patients to heart failure is extremely wide. Health-care professionals in all clinical disciplines should receive education to identify patients with diseases that increase the risk of heart failure and prescribe preventive medications. This ensures that as many people as possible get access to therapy [5, 7, 8].

Patients receiving long-term preventive therapy should be evaluated regularly at the expense of health-care providers. In addition, patients with chronic diseases, such as coronary artery disease or Chagas disease, should periodically evaluate and monitor heart changes. Patients with breast cancer are another group that will benefit from such monitoring. Several existing and new methods of treating cancer are toxic to the heart, and it is important for health professionals to be aware of the need to evaluate and manage the risks involved.

Bacterial infections that cause heart disease are largely eliminated in economically developed countries due to the use of antibiotics. In other regions, bacteria and tropical parasites cause a significant proportion of heart failure, many of which can be prevented by appropriate treatment methods. Therefore, the potential benefits of policy initiatives aimed at eliminating infectious diseases extend to preventing heart failure in many parts of the world. In particular, to continue global efforts, it is necessary to eradicate Chagas disease, based on the progress made in Latin America over the past two decades [1, 2].

Preventive treatment could be started earlier, identifying people with early signs of abnormal cardiac muscle remodeling. Unfortunately, large-scale screening programs, such as those that allowed earlier treatment of bowel cancer, cervical cancer, and breast cancer, are unfortunately not possible, because there is no simple diagnostic test for heart failure. Early changes in the structure or function of the heart can be detected using medical imaging technology; however, it is inadvisable to perform these complex procedures in a large number of people with diseases that lead to heart failure and, of course, not for the general population. In the future, extended genetic tests and statistical modeling of risk groups that take into account the myriad potential causes of heart failure may be available, and this can allow individuals to be identified for in-depth screening.

Targeting preventive drugs to people with the highest risk of heart failure can increase profitability, allowing more people to take advantage. Further research in these areas continues and should continue to be supported by public and private funds. In addition, information programs should be directed at everyone who has medical conditions that predispose to heart failure. They should include education about the symptoms of heart failure and the benefits of positive lifestyle changes. The same messages are important for public information programs [3–6].

Preventing heart failure in the elderly is becoming a more urgent health priority, as the age of the population. Heart failure is the most common cause of hospitalization in people older than 65 years in economically developed regions. Elderly patients hospitalized with heart failure mostly are women. Although a number of studies of patients with heart failure have

shown that survival rates are better in women than in men, recent studies have shown that long-term prospects for women are not as good as previously thought. Therefore, initiatives aimed at improving the prevention of heart failure should include strategies to reach older people, especially older women [14–16].

In economically developed countries, heart failure is more common and most likely the cause of death in people with low socioeconomic status than the rest of the population. This is still the case after adjusting for age differences, the use of drugs, and the proportion of people with other cardiac diseases. The view was expressed that the role of housing can be played by housing stability, social support, substance abuse, language skills, and distance to the hospital.

Several studies have reported a reduction in the risk of heart failure with a healthy lifestyle. It has been shown that healthy weight, avoidance of smoking, exercise, and healthy eating reduce the risk factors for heart failure, including ischemic disease, diabetes, and hypertension. Recently, researchers in the health research of doctors reported that habits of a healthy lifestyle, that is, normal body weight, rather than smoking, regular exercise, moderate alcohol consumption, consumption of breakfast cereals, and consumption of fruits and vegetables, were associated with a lower risk of heart disease with the most high risk of 21.3% in men who do not observe any of these habits and the lowest risk of 10.1% in men who adhere to 4 or more of them.

#### **4. Healthy lifestyle, behavior, and socioeconomic issues**

Although many heart failure risk factors have been described, determining their role in predicting a future event is still difficult. Despite a strong etiological relationship to the disease, the risk factor may be limited in its prognostic role. Although individual risk factors for heart failure, such as hypertension, are well described, how do we clearly identify individual risk in patients with different combinations of risk factors? For coronary events, schemes for predicting multiple risks have been developed, for example, the Framingham risk score. However, heart failure syndrome is a spectrum from ischemic to nonischemic etiology and from normal to depressed ejection fraction. Older patients may develop heart failure due to age-related cardiovascular changes in the absence of traditional risk factors. Thus, high-risk subjects cannot be detected using coronary risk regimes [15].

Several unique problems make the assessment of the risk of heart failure difficult. First, heart failure is a clinical diagnosis, and this leads to a variety of opinions and diagnostic uncertainties in a number of cases. The most common clinical criteria used to diagnose heart failure are the Framingham criteria, which require at least two basic or one basic and two lower criteria. The main criteria include paroxysmal nocturnal dyspnea, a dilated vein in the throat, rales, radiographic cardiomegaly, acute pulmonary edema, gallop S3, increased venous pressure > 16 cm H<sub>2</sub>O, circulation time ≥ 25 seconds, hepatojugular reflux or pulmonary edema, or visceral cluster or cardiomegaly at the autopsy. Minor criteria included bilateral ankle edema, night cough, shortness of breath with normal tension, hepatomegaly, pleural effusion, a



decrease in vital capacity by one-third of the maximum, and heart rate  $\geq 120$  beats per minute. Researchers from the cardiovascular study have developed alternative criteria that included the use of drugs and imaging techniques. When both sets of criteria were compared, only half of the patients were considered to have heart failure by both criteria, while the other half were labeled either one or the other, but not both. A similar discrepancy was shown between diagnoses of administrative categories compared to a detailed overview of the diagram [2, 13–16].

Social changes can affect the CVD epidemic in different ways. It may be influenced by globalization, migration, socioeconomic changes, and unemployment. Over the years, differences in the incidence of CVD among countries, regions, and areas have increased; these inequalities can be explained by the components of human behavior, such as diet, exercise, smoking, and work-related functions, as well as overcrowding, unemployment, and other deprivation indicators. The expected life expectancy is constantly increasing with income.

## 5. Smoking of tobacco

Smoking is a strong predictor of heart failure in men and women; 45% and 88% have an increased risk. The harmful effect of tobacco, apparently, does not depend on the form of use. An increased risk of cardiovascular disease is reported when tobacco is used by non-smokers. There is no “safe” level of smoking; a single cigarette can strengthen the left ventricle, and only one to four cigarettes a day double the risk of myocardial infarction. Mechanisms leading to heart failure in smokers include (i) indirect effects, that is, causing or exacerbating associated diseases associated with heart failure, and (ii) direct exposure to the myocardium.

Tobacco smoking remains one of the most important preventable causes of premature mortality, and quitting is the most cost-effective strategy for the prevention of cardiovascular disease. Improvements have been made with regard to tobacco smoking, in some countries more than in others, with large differences in accordance with the socioeconomic class. Governmental constraints and rules were successful; high taxes on tobacco products are the most effective policy measure to reduce smoking among young people. However, this needs to be complemented by continuing campaigns in the field of health education, especially those targeting young people and other subgroups of society. There must be restrictions on advertising, promotion, and sponsorship by the industry [12, 16].

All smokers should be advised to quit. Patients should be referred to formal programs to discontinue therapy, and pharmacological therapy should be offered to increase success. Current recommended strategies include the following: (a) Medicines. Several drugs are available for tobacco dependence. Seven first-line drugs significantly increase long-term rates of abstinence from smoking, including bupropion SR, nicotinic gum or inhaler or cake or nasal spray, or patch and varenicline. (b) Counseling and psychosocial support. Individual, group, and telephone practical consultations and social support are effective, and their effectiveness increases with the intensity of treatment. (c) Combination. However, the combination of counseling and medication is more effective than one, so clinicians should encourage all people who attempt to stop using both counseling and medication.

Smokers who want to quit smoking should get professional help if needed. Short interventions with recommendations for cessation of smoking, together with pharmacological support and follow-up visits, are effective and safe, but not enough, even for smokers with established ischemic heart disease. If the smoker is ready to stop, a termination plan should be prepared, including the release date, information for friends and families asking for support, and removing all tobacco and smoking-related items from the immediate environment and, finally, ideally within a month and every month after that for 4 months. On a subsequent visit, a person should be congratulated if he/she has stopped smoking. In case of relapse, a more intensive approach should be considered, for example, referral of a specialist or center for cessation of smoking. Avoidance of secondhand smoke is another important recommendation for CVD prevention.

If the recommendations, stimulation, and motivation are likely to be insufficient, drug therapy should be considered at an early stage, including nicotine replacement therapy (NRT), bupropion, or varenicline. Pharmacotherapy for smoking cessation can double or triple throw rates, and a combination of pharmacotherapy and counseling improves throw rates.

The success of cessation of smoking with varenicline is higher than with bupropion; varenicline doubles the chances of stopping smoking compared to placebo. Varenicline reduces cravings for cigarettes and withdrawal symptoms; it should be run 1 to 2 weeks before the release date. Hypersensitivity is the only contraindication. Nausea is the most common side effect, especially at the beginning of therapy and if taken with food. In some cases, a dose titration may be required.

Electronic cigarettes, or e-cigarettes, can deliver high concentrations of nicotine as a vapor and have been recommended as a measure to help stop smoking conventional cigarettes. The results of studies of the cardiovascular effect of electronic cigarettes are inconsistent, but in some cases, an increased risk is documented.

## 6. Dietary habits

As for the dietary habits of the population, the changes occurred in different areas. For example, consumption of salt and saturated fats has been reduced in most societies. The food industry has reduced the presence of trans-fatty acids in different foods. This was promoted by regulatory initiatives in some communities. Nevertheless, the potential for preventing cardiovascular disease through dietary adaptations is still poorly implemented. Compliance with a balanced diet is usually limited. Control of high blood pressure, dyslipidemia, and dysglycemia can be significantly improved due to lifestyle changes. Achieving better adherence to dietary recommendations requires an understanding of the determinants of poor compliance. At the population level, structural measures, such as product information and user-friendly food labeling, can improve health-friendly options. Energy-intensive products with nutrient deficiencies are usually highly available and inexpensive; marketing of such products may be limited and taxed.

In the diet “Dietary Approaches to Stopping Hypertension” (DASH), people are encouraged to consume more (i) fruits and vegetables; (ii) grains and cereals; (iii) lean meat, fish, and

poultry; (iv) low-fat or low-fat dairy products; and (v) nuts, seeds, and pulses and reduce consumption of red meat, fat, and sugar while maintaining low-sodium intake. Initially it was elevated for hypertension; however, recent data confirm a reduction in the risk of heart failure with an observed decrease of 37% in women who adhere to the DASH diet. The DASH diet can help prevent heart failure by lowering blood pressure and coronary heart disease. Daily consumption of whole grain breakfast cereals was associated with a 30% reduction in heart failure, egg consumption more than twice a day was associated with an increase of 64%, fish consumption was associated with a 20–31% lower heart failure rate depending on consumption, and consumption of 100 mmol or more of sodium was associated with a 26% rate; only the consumption of nuts was not associated with heart failure. Whole grains can protect against the risk of heart failure as a result of exposure to weight, hypertension, myocardial infarction, and diabetes mellitus.

Fish consumption has a beneficial effect on the risk of heart failure with about 20% less risk associated with consumption one to two times a week and about 30% less risk when consumed  $\geq 3$  times a week, compared with consumption less than one time per week/month. The estimated consumption of marine n-3 fatty acids was associated with a 37% reduction in the risk of heart failure in the highest quintile of consumption compared to the lowest. Short-term tests of fish oil supplementation of 3–5 g per day can reduce the risk, while dietary doses of about 0.5 g per day can lead to more modest effects, which over time can reduce the risk of heart failure. It has been reported that the consumption of fried fish or baked fish is inversely related to systolic blood pressure, C-reactive protein level, and carotid intimal medial thickness, while consumption of fried fish is positively associated with them, indicating that the type of preparation can influence the effects.

At the clinical level, general practitioners have the opportunity to provide advice on a diet for treating risk factors for coronary diseases. However, obstacles related to time constraints, knowledge, and perceived effectiveness were reported. The degree to which doctors are familiar with a healthy dietary pattern (i.e., DASH, the Mediterranean diet) and with the translation of this information into practical recommendations may be limited. A multidisciplinary approach, including dieticians and nutritionists, can help but needs to improve coverage of reimbursement.

At the individual level, new strategies can help improve patient self-control and lead to a sustained behavior change. Many applications and devices are available that provide data that can be useful for lifestyle changes and patient self-care.

## 7. Physical activity

Physical inactivity is an important risk factor for cardiovascular disease, including heart failure. Regular physical activity has important and broad benefits, such as reducing the risk of cardiovascular disease, hypertension, and diabetes. Physical activity is a key to good health and an important component of weight loss and weight maintenance, improving the profile of lipoproteins and reducing the risk of hypertension, diabetes, and coronary artery disease. These favorable effects on the profile of cardiovascular risks, in turn, reduce the likelihood of heart failure [14–16].

Promotion of physical exercises is a crucial and central issue in all strategies for the prevention of cardiovascular diseases. At the individual level, physical activity should be recommended at different times; he must become part of ordinary life from childhood. Children and adolescents should be encouraged to spend from 30 to 45 minutes of exercise at school or in their free time every day. This should be maintained as long as possible, through adolescence to adulthood.

Physical activity can also reduce left ventricular hypertrophy and improve endothelial function. Chronic physical activity reduces the production of cytokines by fat tissue, skeletal muscles, and endothelial and blood mononuclear cells and regulates antioxidant enzymes. These modifying effects on risk factors for heart failure or the intermediate pathways leading to heart failure can reduce heart failure. Integration of physical activity into everyday life of the population proved to be a difficult task.

Healthy adults in all age groups are encouraged to choose pleasant physical exercises that fit into everyday life on most days of the week. It is recommended to perform at least 150 minutes per week of moderate aerobic physical activity (30 minutes for 5 days a week) or 75 minutes per week of intense aerobic physical activity (15 minutes for 5 days a week) or a combination thereof. At the individual level, the purpose of the exercise should be more personalized. Therefore, a brief history of the individual's physical level is needed (how many minutes per day is spent on average with activity at moderate or strong intensity).

Currently, the recommendations of the American College of Sports Medicine and the American Heart Association for regular physical activity in healthy adults 18–65 years include the following: (a) Aerobic activity. Aerobic physical activity with moderate intensity for at least 30 minutes for 5 days a week or intense aerobic activity for a minimum of 20 minutes for 3 days a week. (b) Strengthening of muscles. It is recommended that 8–10 exercises are performed for 2 or several days without Monday to a week using the main muscle groups. To maximize the development of strength, you should use resistance (weight), which allows you to perform 8–12 repetitions of each exercise, which leads to strong-willed fatigue. (c) Dose of activity. Activity of intensive intensity can have a greater benefit than physical activity of medium intensity.

Walks have been reported as useful for primary prevention; this should be done by individuals who do not adhere to current recommendations.

Based on this and taking into account the individual choice, it is possible to give advice on the most appropriate activities, on how to move forward, about what goals should be set to achieve and maintain health benefits from active lifestyles. It is necessary to identify barriers to achieving a more active lifestyle, perceived by the individual, and to explore ways of overcoming them. For people at work, it is recommended to recommend an active trip, as well as active breaks from long periods of sitting. In people who are not able to perform a minimum, or in inactive subjects who are just beginning to engage in any activity, even the lowest recommended level should be recommended. It should be emphasized that any increase in activity will be associated with a beneficial health impact, even before the learning effect becomes apparent, and that it is normal for gradual work for any given purpose.

### 7.1. Overweight and obesity

There are several plausible mechanisms for the association of obesity and an increased risk of heart failure. Indirect but well-known and documented mechanism is the effect of obesity in heart failure with the help of other risk factors. The increase in BMI is a risk factor for the development of hypertension, diabetes mellitus, and dyslipidemia, all of which increase the risk of myocardial infarction, which is an important precursor of heart failure. In addition, hypertension and diabetes mellitus independently increase the risk of HF occurrence. It has also been shown that increased BMI is associated with altered left ventricular remodeling, possibly due to increased hemodynamic loading, neurohormonal activation, and increased oxidative stress. Studies have shown that obesity can have a direct effect on the myocardium, demonstrating a loss of cardiac function through cardiac steatosis and lipoapoptosis.

The body mass index is associated with heart failure in a positive and linear way in both sexes. Although the body mass index in the obesity area ( $\geq 30$  kg/m<sup>2</sup>) is clearly associated with an increased risk of heart failure, there are disputes regarding the body mass index in the overweight range (25–29.9 kg/m<sup>2</sup>). However, recent data confirm that overweight is also associated with heart failure. Abdominal obesity may be a stronger predictor of heart failure than complete obesity, even in the absence of coronary heart disease. Several mechanisms have been proposed that increase the body mass index, the risk of heart failure, including (a) changes in the cardiac load, (b) changes in cardiac structure and function, (c) activation of neurohumoral and inflammatory pathways, (d) promotion of atherogenic conditions, (e) a predisposition to breathing with sleep disorders, and (f) a chronic kidney disease.

Although elevated BMI is well known as a risk factor for heart failure, this study showed that an elevated BMI is not a risk factor for increasing mortality but rather is associated with a trend toward improved survival. This counterintuitive epidemiological link between survival outcomes and traditional risk factors is called reverse epidemiology or “paradoxical obesity,” and it is now well documented in numerous studies and in the literature on heart failure.

The exact mechanisms underlying the paradox of obesity have not been clearly defined. There are several theories. A common explanation for the increase in survival in obese patients with heart failure is that additional fatty tissue provides greater reserves against catabolic changes associated with the disease process that can lead to cardiac cachexia. Cardiac cachexia is a syndrome that includes progressive weight loss and changes in the body composition, which carries a destructive prognosis for heart failure, as well as in other painful conditions.

The basic approach to risk reduction for obese patients should include weight control and physical activity, as well as control of related risk factors such as hypertension, diabetes, sleep disorders, and metabolic syndrome components. Changes in the myocardium with nonsurgical or surgical weight loss are possible, and a slight weight loss is effective; weight loss of 10% reduces systolic dysfunction, and a weight loss of 8–10 kg leads to a significant decrease in the size of the left ventricle and the mass index and improves diastolic function. Significant weight loss reduces the thickness and volume of the wall of the left ventricle, filling pressure, improves diastolic parameters, and improves systolic function of the left ventricle. The role of metabolic and neurohumoral modification may take precedence over hemodynamic effects, since left ventricular mass or functional improvement occurs independently of load changes.

## 7.2. Alcohol consumption

Although epidemiological data constantly demonstrate the harmful effects on health associated with alcohol use, current literature cites some evidence of reducing the risk of heart failure with mild and moderate alcohol consumption. However, in order to fully understand the relationship between mild to moderate alcohol consumption and heart failure, several gaps need to be filled, especially the role of alcohol samples, beverage types, and genetic variations affecting alcohol metabolism and the effect of light on moderate drinking in predicting mortality and concomitant morbidity among people with heart failure. In the absence of large randomized studies of moderate alcohol consumption and heart failure, residual mixing or immeasurable confusion cannot be ruled out as possible explanations of the observed relationships. Thus, for patients who do not consume alcohol, it would be premature to recommend mild to moderate alcohol consumption as a means to reduce the risk of HF, given the possible risk of abuse and the resulting consequences.

Excessive consumption of alcohol is associated with alcoholic cardiomyopathy. Interestingly, other data are consistent with the possible benefits of moderate alcohol consumption for the risk of heart failure. In addition, it was reported that mild to moderate alcohol consumption is associated with a 40–50% lower risk of heart failure than with a previous myocardial infarction, whereas in the same study, the risk of heart failure without previous myocardial infarction among people who use heavy drinks was 1.7 times higher than that of abstained. Similar results were presented in the study of the health of doctors. The favorable effects of alcohol on the risk of developing hypertension, myocardial infarction, and diabetes mellitus have also been reported, while alcohol increases the level of high-density lipoprotein cholesterol, increases insulin sensitivity, reduces the level of inflammatory markers and clotting factors in plasma, and increases the level of adiponectin.

## 8. Management of cardiovascular risk factors

All current guidelines on the prevention of CVD in clinical practice recommend the assessment of total CVD risk because atherosclerotic CVD is usually the product of a number of risk factors. Prevention of CVD in a given person should be adapted to his or her total CVD risk: the higher the risk, the more intensive the action should be. The stratification of the community into different levels of total CVD risk was given in recent guidelines.

### 8.1. Dyslipidemias

The treatment goals for LDL-C depend on the total CVD risk of the patient and of the baseline LDL-C level. In patients at very high CVD risk, an LDL-C goal of <1.8 mmol/L (70 mg/dL), or a reduction of at least 50% if the baseline LDL-C level is between 1.8 and 3.5 mmol/L (70 and 135 mg/dL), is recommended.

In patients at high CVD risk, an LDL-C goal of <2.6 mmol/L (100 mg/dL), or a reduction of at least 50% if the baseline LDL-C level is between 2.6 and 5.2 mmol/L (100 and 200 mg/dL), is recommended. In subjects at moderate risk, an LDL-C goal of <3.0 mmol/L (115 mg/dL) should be considered.

Statins have proven effective in patients with coronary heart disease; however, their usefulness in staging left ventricular dysfunction remains under investigation. The role of statins in the prevention of heart failure is shown.

Based on the results of the IMPROVE-IT study, further reduction in LDL-C by the addition of ezetimibe should be considered in patients with cardiovascular diseases with LDL-C  $\geq 70$  mg/dl ( $\geq 1.8$  mmol/L), despite the maximum allowable dose of statin. Now a new family of drugs that lower lipid levels is available. These inhibitors of subtilisin/kexin type 9 retardate convertase (PCSK9) further reduce LDL-C in addition to what can be achieved with statins. In a FOURIER study, inhibition of PCSK9 with evolocumab against statins lowered LDL-C to a median of 30 mg/dL (0.78 mmol/L) and reduced cardiovascular events. The use of this drug should be considered in patients with a very high risk of cardiovascular disease, in which LDL-C remains elevated, despite the fact that it is treated with a maximum dose of statins in combination with ezetimibe or in patients with statin intolerance.

## 8.2. Arterial hypertension

Elevated blood pressure (BP) is one of the most powerful modifiable risk factors for cardiovascular disease. The beneficial effects of lowering blood pressure on the reduction of stroke, myocardial infarction, heart failure, and death have been shown in numerous RCTs and in various meta-analyses. BP reduction can be achieved through lifestyle changes and drug therapy [17–19].

Progression progresses from hypertension to structural changes in the ventricles and systolic and diastolic ventricular dysfunction. The increase in chronic load, left ventricular mass, and stress, accompanied by a deterioration in the properties of diastolic filling, occurs in a chronic environment. Disproportionately increased left ventricular mass leads to inadequate microcirculation for perfusion of the hypertrophied myocardium, which leads to subendocardial hypoperfusion, ischemia. These changes increase the risk of developing coronary thrombosis and a heart attack characterized by loss of contractile function, neurohormonal activation, and ventricular remodeling, which leads to the development of systolic dysfunction. Anomalies in neurohormonal activation and the balance of water and electrolyte also play a role in the cascade, which leads to hypertension to heart failure [20–22].

## 8.3. Dysglycemia and diabetes mellitus

In people with impaired glucose tolerance, the development of type 2 diabetes mellitus (DM) can be delayed or prevented. In patients with type 2 diabetes, cardiovascular disease can be prevented by good control of risk factors for cardiovascular disease. Intensive management of hyperglycemia also reduces the risk of microvascular complications.

Diabetes mellitus is an independent risk factor for heart failure in all age groups. The relative risk of heart failure in patients with diabetes varies from 1.3 to 2.7, increasing to 4 in patients under the age of 65 and 11 in individuals younger than 45 years. Several mechanisms have been proposed to explain the increased risk. Combinations associated with heart failure, including obesity, hypertension, and coronary artery disease, are common among people

with diabetes. Insulin resistance itself can cause disturbances in the cardiac structure and function [23–25].

Unfortunately, the prevalence of type 2 DM increases in most parts of the world, mainly because of unbalanced diets and lack of physical activity. The diagnosis of DM is also problematic in a large number of people and even in patients with established CVD. Screening should be considered by evaluating HbA1c or fasting blood glucose levels. When there is any doubt, you should offer a test for glucose tolerance orally.

For most nonpregnant adults with type 1 or type 2 DM, it is recommended to reduce HbA1c < 7.0% (<53 mmol / mol) to reduce the risk of cardiovascular disease and the risk of microvascular complications. When diagnosed or at the beginning of a DM, the target HbA1c  $\leq$  6.5% ( $\leq$ 48 mmol/mol) should be considered in patients who are not brittle and do not have CVD.

Metformin is recommended as first-line therapy if it is tolerated and not contraindicated after assessing kidney function. In patients with diabetes and cardiovascular disease, the use of sodium glucose-based cotransporter-2 (SGCT2) inhibitors reduced cardiovascular and total mortality without significant adverse effects. These drugs should be considered at an early stage of treatment of DM in these patients. Optimal management of LDL-C and BP levels is of great importance for all patients with DM [3, 24, 25].

#### **8.4. Public awareness of heart failure and compliance**

Appropriate care for heart failure and adequate provision of care and research require recognition of its clinical, social, and economic importance not only by health authorities and providers of health services but also by the general public. Without recognition of the symptoms and their severity, people with heart failure will not seek immediate treatment—patients often present with a long history of dyspnea. Awareness of the causes of HF can help to make appropriate lifestyle changes to reduce the risk. In addition, awareness of the benefits of treatment can help compliance and encourage patients to seek appropriate care. However, there is a lack of information about public awareness of HF. Studies have shown a relatively low understanding and treatment of heart failure by general practitioners. If doctors are not aware of the importance of HF, it is unlikely that the general public will have a good understanding [26–28].

A large number of premature deaths are due to ignorance of the causes and symptoms of heart failure. There is an urgent need for public information programs that determine heart failure in a simple and accessible language, explain how to recognize symptoms, and stress the need for emergency medical care. Other important messages are that most types of heart failure can be prevented and a healthy lifestyle can reduce the risk. Policymakers should support the development and implementation of public awareness programs targeted at these messages. The public understanding of the symptoms of heart failure is dangerously low.

Cost-effective information, education, and support programs to reduce the risk of heart failure should be at the forefront of public health guidelines. Lifestyle events can have a significant impact on the health of the world, because obesity, diabetes, cigarette smoking, and high blood pressure significantly increase the likelihood of heart failure. Renewing commitment



to public education, the importance of healthy nutrition and weight, regular exercise, and prevention of smoking should be a priority for policymakers [29, 30].

In low- and middle-income countries, lifestyle-based measures to prevent heart failure were calculated as more cost-effective than pharmaceutical interventions. The acute need to take risks into life throughout the world is recognized by the United Nations, including in regions such as sub-Saharan Africa, where noncommunicable diseases associated with western lifestyles are not yet the leading causes of death or disease. Given the increasing number of patients with heart failure in economically developing regions, governments should be encouraged to combine lifestyle-based preventive measures with their programs to combat hunger and the epidemic. One could consider the issue of regulating aggressive marketing of high-calorie foods by large global corporate enterprises, especially schoolchildren and adolescents [31–33].

Compliance with the recommendations of clinical practice is often associated with improved outcomes for patients with heart failure. However, in many countries there are significant differences in how closely hospitals follow the recommendations of national recommendations for heart failure. In response, policymakers must protect the fairness of care for all patients. First, it is important to promote heart failure training programs that raise awareness of the guidelines among all relevant health professionals. Secondly, better care should be encouraged, using performance indicators and incentives appropriate to local conditions. Funding is needed to research evidence-based health-care performance indicators that reflect improvements in clinical outcomes for patients with heart failure. By improving health care, policymakers can provide a health system that provides timely access to the diagnosis and treatment of heart failure and then a consistent transition to long-term management.

Diagnosis of heart failure can be difficult, even for skilled professionals. Not all patients with heart failure have typical symptoms, and the same symptoms can be experienced by patients who do not have heart failure. For an accurate diagnosis, a number of diagnostic tools and information are required in combination with clinical judgment and expert knowledge.

Many patients initially do not see an expert in heart failure due to the fact that they are part of the health-care system. Those with severe symptoms, such as dyspnea at rest, are most often evaluated by paramedics or emergency doctors in the hospital, whereas those with less obvious life-threatening symptoms are more likely to go to their family doctor or outpatient clinic. Educational programs are needed to raise awareness about clinical practice recommendations among health professionals from a wide range of specialties that may be the first to encounter patients with undiagnosed heart failure.

Recommendations for the use of drugs for the treatment of heart failure are based on clinical trials conducted mainly in Europe and the United States. In other parts of the world, the underlying causes of heart failure are different, and it is not safe to assume that drugs will be equally effective in all patient groups. A further clinical study to investigate the efficacy of treating heart failure in different patient groups around the world should be maintained [32–34].

The world survey showed the need to improve patients' self-care. Most patients reported taking medication as prescribed, but few reported having control of their weight or regular training. Educational programs are a priority, but they need to be developed carefully,

because it is reported that patients with a deeper knowledge of heart failure are more likely to delay treatment. This may reflect false optimism and a lack of understanding that controlling the symptoms of heart failure does not slow the progression of the disease. The learning environment should also be carefully considered. Short video clips, text messages, and social networks can be used to deliver simple but accurate messages. Currently, according to estimates, 6 billion people own a mobile phone; technology can be an important way to reach remote and socially economically disadvantaged [27–31].

Teaching people how to support a partner, family member, or friend with heart failure is also an important part of encouraging self-help. Patients are more likely to engage in useful self-help if they have someone who will help them than if they were socially isolated. This emphasizes the need to improve support for communities of socioeconomically disadvantaged patients and those who live alone. Policymakers should provide resources to educate and support people with heart failure and their caregivers, allowing them to actively engage in long-term care.

## 9. Conclusion

Prevention of disease and death due to heart failure should be a priority in the field of health. Despite the increasing number of people living and dying of heart failure, awareness of this disease is low among the public, politicians, and even some health professionals. Despite the lack of treatment for heart failure, many cases can be prevented, and most patients can effectively be treated to improve quality of life and survival. Policymakers are responsible for ensuring that as many people as possible can take advantage of affordable prevention, diagnosis, treatment, and long-term treatment of heart failure. At the same time, research should be supported in areas where immediate unmet needs exist.

All current recommendations for the prevention of cardiovascular disease in clinical practice recommend an estimate of the overall risk of cardiovascular disease, since atherosclerotic cardiovascular risk is usually the result of a number of risk factors. Prevention of cardiovascular disease in this person should be adapted to his or her overall risk of cardiovascular disease: the higher the risk, the more intense the action should be.

The positive impact of specialized management programs on survival suggests that these factors also lead to a significant number of preventable deaths. Many of the factors listed above are often considered in “normal conditions” of clinical trials with increased monitoring and individualized observation. It is therefore not surprising that patients in clinical trials usually have lower than expected morbidity and mortality rates.

Any program aimed at improving long-term management must recognize that patients with heart failure play a key role in their own care. Self-service includes maintenance, monitoring, and management. Maintenance involves taking medication as prescribed, regular meals, and a healthy diet. Monitoring involves monitoring of symptoms and weight (which can serve as a warning sign of increasing fluid accumulation). Management involves responding to changes in symptoms by adjusting the doses of certain drugs if they are prescribed for “use as needed” (e.g., drugs that increase urine production to reduce fluid accumulation) or by seeking medical help if symptoms worsen.

## Author details

Oleksii Korzh

Address all correspondence to: okorzh2007@gmail.com

Department of General Practice-Family Medicine, Kharkiv Medical Academy of Postgraduate Education, Kharkiv, Ukraine

## References

- [1] Robertson J, McElduff P, Pearson SA, et al. The health services burden of heart failure: An analysis using linked population health data-sets. *BMC Health Services Research*. 2012;**12**:103. DOI: 10.1186/1472-6963-12-103
- [2] Sato N, Kajimoto K, Keida T, et al. Clinical features and outcome in hospitalized heart failure in Japan (from the ATTEND registry). *Circulation Journal*. 2013;**77**:944-951
- [3] Cleland JG, Swedberg K, Follath F, et al. The EuroHeart failure survey programme—A survey on the quality of care among patients with heart failure in Europe. Part 1: Patient characteristics and diagnosis. *European Heart Journal*. 2003;**24**:442-463
- [4] AlHabib KF, Elasar AA, Alfaleh H et al. Clinical features, management, and short- and long-term outcomes of patients with acute decompensated heart failure: Phase I results of the HEARTS database. *European Journal of Heart Failure*. 2014: DOI: 10.1002/ejhf.57
- [5] Roger VL, Weston SA, Redfield MM, et al. Trends in heart failure incidence and survival in a community-based population. *Journal of the American Medical Association*. 2004;**292**:344-350
- [6] Huelsmann M, Neuhold S, Resl M, et al. PONTIAC (NT-proBNP selected prevention of cardiac events in a population of diabetic patients without a history of cardiac disease): A prospective randomized controlled trial. *Journal of the American College of Cardiology*. 2013;**62**:1365-1372
- [7] Ledwidge M, Gallagher J, Conlon C, et al. Natriuretic peptide-based screening and collaborative care for heart failure: The STOP-HF randomized trial. *Journal of the American Medical Association*. 2013;**310**:66-74
- [8] Felker GM, Hasselblad V, Hernandez AF, et al. Biomarker-guided therapy in chronic heart failure: A meta-analysis of randomized controlled trials. *American Heart Journal*. 2009;**158**:422-430
- [9] Persson H, Erntell H, Eriksson B, et al. Improved pharmacological therapy of chronic heart failure in primary care: A randomized study of NT-proBNP guided management of heart failure—SIGNAL-HF (Swedish Intervention study—Guidelines and NT-proBNP AnaLysis in Heart Failure). *European Journal of Heart Failure*. 2010;**12**:1300-1308

- [10] Shah MR, Califf RM, Nohria A, et al. The STARBRITE trial: A randomized, pilot study of B-type natriuretic peptide-guided therapy in patients with advanced heart failure. *Journal of Cardiac Failure*. 2011;**17**:613-621
- [11] Gaggin HK, Mohammed AA, Bhardwaj A, et al. Heart failure outcomes and benefits of NT-proBNP-guided management in the elderly: Results from the prospective, randomized ProBNP outpatient tailored chronic heart failure therapy (PROTECT) study. *Journal of Cardiac Failure*. 2012;**18**:626-634
- [12] O'Connor CM, Hasselblad V, Mehta RH, et al. Triage after hospitalization with advanced heart failure: The ESCAPE (Evaluation Study of Congestive Heart Failure and Pulmonary Artery Catheterization Effectiveness) risk model and discharge score. *Journal of the American College of Cardiology*. 2010;**55**:872-878
- [13] Kociol RD, McNulty SE, Hernandez AF, et al. Markers of decongestion, dyspnea relief, and clinical outcomes among patients hospitalized with acute heart failure. *Circulation: Heart Failure*. 2013;**6**:240-245
- [14] Son CS, Kim YN, Kim HS, et al. Decision-making model for early diagnosis of congestive heart failure using rough set and decision tree approaches. *Journal of Biomedical Informatics*. 2012;**45**:999-1008
- [15] Kelder JC, Cramer MJ, Van WJ, et al. The diagnostic value of physical examination and additional testing in primary care patients with suspected heart failure. *Circulation*. 2011;**124**:2865-2873
- [16] Zairis MN, Tsiaousis GZ, Georgilas AT, et al. Multimarker strategy for the prediction of 31 days cardiac death in patients with acutely decompensated chronic heart failure. *International Journal of Cardiology*. 2010;**141**:284-290
- [17] McMurray JJV, Packer M, Desai AS, et al. Angiotensin-neprilysin inhibition versus enalapril in heart failure. *The New England Journal of Medicine*. 2014;**371**:993-1004
- [18] Yusuf S, Teo KK, Pogue J, et al. Telmisartan, ramipril, or both in patients at high risk for vascular events. *The New England Journal of Medicine*. 2008;**358**:1547-1559
- [19] Yusuf S, Teo K, Anderson C, et al. Effects of the angiotensin-receptor blocker telmisartan on cardiovascular events in high-risk patients intolerant to angiotensin-converting enzyme inhibitors: A randomised controlled trial. *Lancet*. 2008;**372**:1174-1183
- [20] Sakata Y, Shiba N, Takahashi J, et al. Clinical impacts of additive use of olmesartan in hypertensive patients with chronic heart failure: The supplemental benefit of an angiotensin receptor blocker in hypertensive patients with stable heart failure using olmesartan (SUPPORT) trial. *European Heart Journal*. 2015;**36**:915-923
- [21] Eschalier R, McMurray JJV, Swedberg K, et al. Safety and efficacy of eplerenone in patients at high risk for hyperkalemia and/or worsening renal function: Analyses of the EMPHASIS-HF study subgroups (Eplerenone in Mild Patients Hospitalization and Survival Study in Heart Failure). *Journal of the American College of Cardiology*. 2013;**62**:1585-1593

- [22] Rouleau JL, Pfeffer MA, Stewart DJ, et al. Comparison of vasopeptidase inhibitor, omapatrilat, and lisinopril on exercise tolerance and morbidity in patients with heart failure: IMPRESS randomised trial. *Lancet*. 2000;**356**:615-620
- [23] Bohm M, Robertson M, Ford I, et al. Influence of cardiovascular and noncardiovascular co-morbidities on outcomes and treatment effect of heart rate reduction with ivabradine in stable heart failure (from the SHIFT Trial). *American Journal of Cardiology*. 2015;**116**:1890-1897
- [24] Piller LB, Baraniuk S, Simpson LM, et al. Long-term follow-up of participants with heart failure in the antihypertensive and lipid-lowering treatment to prevent heart attack trial (ALLHAT). *Circulation*. 2011;**124**:1811-1818
- [25] Kostis JB, Davis BR, Cutler J, et al. Prevention of heart failure by antihypertensive drug treatment in older persons with isolated systolic hypertension. SHEP Cooperative Research Group. *Journal of the American Medical Association*. 1997;**278**:212-216
- [26] Xie X, Atkins E, Lv J, et al. Effects of intensive blood pressure lowering on cardiovascular and renal outcomes: Updated systematic review and meta-analysis. *Lancet*. 2016;**387**:435-443
- [27] Heidenreich PA, Hernandez AF, Yancy CW, et al. Get with the guidelines program participation, process of care, and outcome for medicare patients hospitalized with heart failure. *Circulation. Cardiovascular Quality and Outcomes*. 2012;**5**:37-43
- [28] Butler J, Fonarow GC, Gheorghiade M. Need for increased awareness and evidence-based therapies for patients hospitalized for heart failure. *Journal of the American Medical Association*. 2013;**310**:2035-2036
- [29] Palaniswamy C, Mishkin A, Aronow WS, et al. Remote patient monitoring in chronic heart failure. *Cardiology in Review*. 2013;**21**:141-150
- [30] McAlister FA, Stewart S, Ferrua S, et al. Multidisciplinary strategies for the management of heart failure patients at high risk for admission: A systematic review of randomized trials. *Journal of the American College of Cardiology*. 2004;**44**:810-819
- [31] Riegel B, Moser DK, Anker SD, et al. State of the science: Promoting self-care in persons with heart failure: A scientific statement from the American Heart Association. *Circulation*. 2009;**120**:1141-1163
- [32] Jaarsma T, Stromberg A, Ben Gal T, et al. Comparison of self-care behaviors of heart failure patients in 15 countries worldwide. *Patient Education and Counseling*. 2013;**92**:114-120
- [33] Nieuwenhuis MM, Jaarsma T, van Veldhuisen DJ, et al. Factors associated with patient delay in seeking care after worsening symptoms in heart failure patients. *Journal of Cardiac Failure*. 2011;**17**:657-663
- [34] Gallagher R, Luttik ML, Jaarsma T. Social support and self-care in heart failure. *The Journal of Cardiovascular Nursing*. 2011;**26**:439-445