# Student Heart Failure Intervention Pilot: A Study of Risk Factor Analytics and Population Outreach

William Byron Reichert,[1,2] Gerard Hoatam,[2] Emily Schmidt,[2] Michael Leher,[2] Arathi Gorur,[2] Anna Jones,[2] Anantharam Kalya,[3] Priya Radhakrishnan.[2]

## Abstract

**Background:** Heart failure, the leading cause of hospitalization in adults over the age of 65, is a difficult-to-treat syndrome associated with high morbidity and mortality. Home-monitoring programs may help reduce heart failure-associated morbidity but can be difficult to establish in smaller clinical settings. In this quality improvement project, we identified local patients at high risk of heart failure-related morbidity and hospitalizations, then implemented a medical student-based constant-contact program to encourage their follow-through on self-care. **Methods:** Between June 2012 and September 2014, our clinic treated 197 patients for systolic or diastolic heart failure. These patients' baseline characteristics were evaluated for trends that increased their risk for hospitalization. Of the high-risk patients identified (n=80), 12 (15%) were enrolled in the project. An 8-week constant-contact intervention was initiated through weekly calls. Patients' health statuses were recorded, and the importance of self-care was reiterated. **Results:** High-risk heart failure patients were identified based on >10 clinic visits during the study period; 3 were lost to follow-up. Each patient completed two questionnaires at the study's beginning and conclusion, with response rates of 67% (6/9) and 56% (5/9). Most participants reported symptom improvement and increased knowledge about their conditions. **Conclusion:** Our preliminary population-guided, medical-student-initiated intervention in a small clinical setting was designed to increase patient understanding and compliance and to improve heart failure symptoms. Although the study was limited by its low participation rate, drastic improvements in self-reported outcomes were noted among participants. A larger study with similar positive outcomes could ultimately influence follow-up methods.

**Key Words:** Heart Failure, Population Characteristics, Risk Assessment, Quality Improvement, Medical Student (Source: MeSH-NLM).

## Introduction

**About the Author:** *William Reichert completed his Medical Degree at Creighton University School of Medicine. He is currently training in Internal Medicine with hopes of pursuing a career in cardiology.*

Heart failure (HF) affects an estimated 5.1 million individuals in the US and is the leading cause of hospitalization in adults over 65 years of age. [1, 2] Estimated costs associated with HF range from $37 to $39 billion annually. [3, 4] Current projections state by the year 2030, there will be an estimated 8 million people living with HF in the US, placing a tremendous burden on the national healthcare system. [5] Of equal concern is the fact that 5% of patients in the US healthcare system account for 59% of all national healthcare costs. [6] Recent decades have seen great efforts to drive down the cost of healthcare in the United States and identifying high-risk HF patients—so-called "super-utilizers" of healthcare resources—could facilitate the development of innovative programs that would reduce the costs associated with HF morbidity and hospital admissions. If these patients were more easily identified and more comprehensively educated, it could ease the strain on the national healthcare system.

Numerous innovative management programs have attempted to reduce the costs associated with caring for these super-utilizers. [7] One of the keys to implementing such programs involves the use of evidence-based data to identify this patient population— then, once they are identified, effective interventions must be established. [8] Ideally, these interventions should improve coordination of care and lessen the strain these super-utilizer patients place on the healthcare system. [9, 10] Although some progress has been made in this area, the characteristics of

patients who would benefit from these targeted programs have not been specifically defined for every unique population, and the effectiveness of such efforts in small clinical settings is unknown due to inherent study size limitations. Numerous variables affect one's overall health, including psychosocial, race, gender, socioeconomic, mental health, and traditional risk factors. [11-15] Given the relative homogeneity of patients treated in small clinics for the same condition, it is important to develop programs that target their specific population to maximize the effect of their treatment. To maximize these potential benefits, a novel, small-clinic pilot program was founded with the goal of looking at HF patients specifically—a particularly important population.

Previous studies have described improved coordination of care and positive effects of increased patient education and at-home monitoring programs on HF morbidity and mortality, some reporting a 56% reduction in HF-related readmissions and a 44% reduction in readmissions for reasons unrelated to HF. [16-21] Given the complexity of HF patients and high hospital readmission rates, we designed a program at our academic medical center, which is a Level 3 National Committee for Quality Assurance-certified patient-centered medical home, to address the high morbidity rates associated with HF. Our program, named the Student Heart Failure Intervention Pilot (SHIP), was a medical-student implemented, population-based quality improvement program designed to identify and address unique social determinants responsible for HF-related hospitalizations in a local population. The main goal of this project was to improve

[1] University of Arizona College of Medicine – Phoenix Internal Medicine Residency, Phoenix, USA.
[2] Creighton School of Medicine, Phoenix Regional Campus - St. Joseph's Hospital & Medical Center, Phoenix, USA.
[3] Norton Thoracic Institute-St. Joseph's Hospital & Medical Center, Phoenix, USA.

**Correspondence:**
William B. Reichert, MD.
Banner – University Medical Center Phoenix, Internal Medicine Department, 1111 E. McDowell Rd, Phoenix, AZ 85006.
Email: williambreichert@gmail.com. Phone: (402) 881-0162.

# Original Article

Reichert WB, et al.                                                    Student Heart Failure Intervention Pilot: A Study of Risk Factor Analytics and Population Outreach

morbidity in patients with HF and decrease the number of related hospitalizations through risk factor analysis and telehealth outreach programs. In addition to improving patient care, another goal of this program was to improve medical trainee longitudinal patient exposure by engaging medical students in the continuum of care under the close supervision of an attending physician.

## Materials and Methods

This study was approved by the Institutional Review Board at St. Joseph's Hospital and Medical Center in Phoenix, Arizona and was designed based on Plan–Do–Study–Act protocols in a cross-sectional study design. The Quality Improvement SHIP team consisted of six medical students and an attending physician. The initial cross-sectional study used the Allscripts (Allscripts, Chicago, IL) Ambulatory Electronic Health Record registry to identify 197 patients diagnosed with systolic or diastolic HF at the Internal Medicine and Family Medicine clinics at St. Joseph's Hospital and Medical Center in Phoenix, Arizona, between June 2012 and September 2014 (*Table 1*). Baseline demographic information and comorbidities were assessed to identify risk factors for HF admissions in this cohort. The dataset was then cross-referenced with hospital admissions at St. Joseph's Hospital and Medical Center for patients with HF as primary diagnosis. In addition to the demographic data analyzed, we also analyzed income data obtained based on the average income of the neighborhood of each patient's home address. Demographics (including income data) were analyzed as variables, which were then compared between hospitalized and non-hospitalized patients. Number of clinic visits were found to be statistically significant and were used to identify high-risk patients: those who visited the clinic more than 10 times in the previous 2 years were identified as high-risk. Eighty of the 197 (46%) HF patients met this criterion; these high-risk patients were then contacted to participate in the intervention. Of the 80 high-risk patients identified, 12 agreed to participate in the intervention portion of the pilot, a longitudinal study, and informed consent was obtained. This intervention included medical students calling the high-risk patients on the telephone each week. Once the patients were enrolled, the medical students developed a standardized educational curriculum explaining the definition of HF, informing the patients about why it is important to closely monitor HF symptoms, and offering patients ways to maintain functional status under the guidance of (and based on recommendations from) the supervising faculty. These topics were discussed with patients during weekly calls for the duration of the project (minimum of 3 attempts per week); in addition to the informational component of these phone calls, the medical students also asked patients questions about their symptoms and about their understanding of the HF curriculum. We hypothesized that diligent follow-through and independent care would improve patients' knowledge about HF, thus decreasing morbidity and rate of hospital readmissions. The patients' responses were recorded, along with the duration of each call. Three patients were lost to follow-up. Each patient was given the Minnesota Living with Heart Failure Questionnaire (MLHFQ) at the beginning and end of the study, with a response rate of 67% (6/9). Patients also completed a patient preference questionnaire (PPQ), based on established telemedicine satisfaction questionnaires, with a response rate of 56% (5/9). [22] A minimum of three attempts were also made to secure end-of-study questionnaires from each patient.

The unpaired t-test was selected to evaluate the baseline demographics and potential risk factors to compare the means of the two (hospitalized and non-hospitalized) independent groups. This was performed under the assumption of identically distributed samples. Given the small number of participants, only probability values were calculated for statistical analysis at study completion.

## Results

Our program reviewed treatment of 197 patients diagnosed with HF over a two-year period. Hospital admission data were tracked between September 1st, 2013 and September 30th, 2014. During that time, 19 of the 197 HF patients were admitted to the hospital (14 had single visits, 5 had multiple visits). There was a significant difference in the number of clinic visits between the 19 hospitalized clinic patients (mean, 16.89 ± 14.58 visits) and the 178 non-hospitalized clinic patients (mean, 10.38 ± 9.75 clinic visits; $t(195)=2.6195$ $p<0.0095$). This benchmark was used to classify patients at high-risk of HF-related readmission to the hospital. Additional variables assessed can be found in *Table 1*. Of the hospitalized patients for whom income data were available, 47% (8/17) had a household that earned less than $40,000/year; 53% of patients (9/17) had an annual income between $40,000/year and $70,000/year. No hospitalized patients had earnings of more than $70,000/year. This trend was also seen in average number of clinic visits - that is, lower income was correlated with more frequent visits to our clinic (mean clinic visits for <$40,000, $40,000 - $70,000, and >$70,000 annual income was 11, 12, and 5, respectively). Three patients were lost to follow-up during the duration of the program. Of the 3 patients lost to follow-up, 2 never completed a weekly telephone call while the third completed 2 phone calls (of 8 attempts). All 3 patients were counted as lost to follow-up due to their failure to answer or return phone calls; no patient formally withdrew from the study. These patients' data were excluded from all parts of the results, but their baseline demographic data were included in the initial risk analysis.

Responses to the MLHFQ collected after the program's conclusion indicated overall symptom improvement with an average decrease in score of 9 points out of 105 possible points (with lower scores being more desirable; 44.3 ± 34 to 35 ± 26). Before the study, 6 patients were unable to describe the definition of HF to the medical student, could not understand the importance of follow-through on physician instructions, or articulate steps to monitor HF; by the study conclusion, 5 of those 6 patients (83%) were able to convey an understanding of HF and were successful in describing the importance of HF monitoring. Most of the symptomatic patients in the study (7/8; 88%) reported symptom improvement in at least 1 of the following categories: presence of orthopnea, chest pain, pre-syncope, edema, fatigue, or cough.

Responses to the PPQ showed a minimal increase in preference for phone calls from surveyors, from a mean score of 41 ± 9 points at the study outset to 43 ± 11 at the study conclusion. No single participant reported 100% compliance with physician directives (i.e., smoking cessation, recording weight and blood pressure daily). *Table 2* summarizes additional results from the intervention portion of the study.

## INTERNATIONAL JOURNAL of MEDICAL STUDENTS

IJMS

Original Article

Reichert WB, et al.                                  Student Heart Failure Intervention Pilot: A Study of Risk Factor Analytics and Population Outreach

**Table 1. Demographics of Hospitalized, Non-hospitalized, and Study Patients.** Data are expressed as n (%), unless indicated otherwise. †One of the nine study patients was recruited from the hospital (not a clinic patient) and therefore was not included in baseline characteristics.

| Variable | | Hospitalized (n=19) | Non-Hospitalized (n=178) | Total (n=197) | p-value | Study (n=8) |
|---|---|---|---|---|---|---|
| **Sex** | Male | 11 (58) | 87 (49) | 98 (50) | | 3 (38) |
| | Female | 8 (42) | 91 (51) | 99 (50) | | 5 (63) |
| **Mean age, years** | | 65 ± 13 | 66 ± 15 | 66 ± 15 | (p=0.26) | 67 ± 12 |
| **Mean BMI, kg/m²** | | 32 ± 9 | 32 ± 10 | 32 ± 10 | (p>.99) | 36 ± 12 |
| **Under- or uninsured** | | 17 (89) | 120 (67) | 137 (70) | | 3 (38) |
| **Race** | White | 10 (53) | 103 (58) | 113 (57) | | 6 (75) |
| | Black | 3 (16) | 19 (11) | 22 (11) | | 0 (0) |
| | Hispanic | 5 (26) | 37 (21) | 42 (21) | | 2 (25) |
| **Comorbidities** | COPD | 4 (21) | 41 (23) | 45 (23) | | 3 (38) |
| | CAD | 8 (42) | 55 (31) | 63 (32) | | 1 (13) |
| | T2DM | 7 (37) | 76 (43) | 83 (42) | | 3 (38) |
| | Hypertension | 15 (79) | 101 (57) | 116 (59) | | 2 (25) |
| **Mean number of medications** | | 14 ± 7 | 14 ± 7 | 14 ± 7 | (p>.99) | 15 ± 2 |
| **Beta blocker** | | 15 (79) | 114 (64) | 129 (65) | | 7 (88) |
| **ACE/ARB** | | 17 (89) | 102 (52) | 85 (43) | | 4 (50) |
| **Furosemide** | | 9 (47) | 109 (61) | 118 (60) | | 4 (50) |
| **Employment status** | Unemployed | 7 (37) | 45 (25) | 52 (26) | | 1 (13) |
| | Employed | 2 (11) | 25 (14) | 27 (14) | | 2 (25) |
| | Retired | 10 (53) | 77 (43) | 87 (44) | | 5 (63) |
| **Marital status** | Married | 6 (32) | 58 (33) | 64 (32) | | 2 (25) |
| | Single | 12 (63) | 82 (46) | 94 (48) | | 5 (63) |
| | Divorced | 1 (5) | 16 (9) | 17 (9) | | 1 (13) |
| | Widowed | 0 (0) | 19 (11) | 19 (10) | | 0 (0) |
| | Deceased | 2 (11) | 23 (13) | 25 (13) | | 0 (0) |

# Original Article

Reichert WB, et al.                                    Student Heart Failure Intervention Pilot: A Study of Risk Factor Analytics and Population Outreach

**Table 2. Characteristics of HF Patients Enrolled in SHIP.** * Twelve patients were initially enrolled in SHIP; 3 were lost to follow-up and were not included in the table. † Data are presented as n (%), unless otherwise specified. ‡ Understanding was defined as medication compliance, ability to recall prescribed medications, and standardized general HF knowledge. § Recorded only if patient was consuming vegetables less than 2 days per week at enrollment. ‖ Symptoms are defined as subjective chest pain, dizziness, swelling, fatigue, and/or cough. ¶ Denominator is 8 as one patient did not have symptoms/lack of understanding at trial start.

| Characteristic | n (%)† |
|---|---|
| Mean age, years | 69 ± 13 |
| Male sex | 4 (44.4) |
| NYHA Class I | 2 (22.2) |
| NYHA Class II | 3 (33.3) |
| NYHA Class III | 4 (44.4) |
| Mean daily medications ± SD | 16.8 ± 3.6 |
| Mean daily cardiac medications ± SD | 2.8 ± 1.1 |
| HF-related hospitalizations (previous year) for enrolled patients | 2 (22.2) |
| HF-related hospitalizations (during SHIP) for enrolled patients | 2 (22.2) |
| Symptomatic patients at time of SHIP enrollment | 8 (88.9) |
| Symptomatic patients who reported improvement at SHIP conclusion | 7/8¶ (87.5) |
| Patients who reported lack of understanding at time of SHIP enrollment‡ | 6/9 (66.6) |
| Patients who had a gap in understanding who later reported increased understanding | 5/6¶ (83.3) |
| Mean increased in fresh vegetable consumption (days per week)§ ± SD | 4.4 ± 1.1 |
| Constant contact | |
| Mean no. of telephone calls completed during study ± SD | 6.2 ± 1.6 |
| Mean completed telephone calls when HF symptoms changed ± SD | 4.9 ± 1.9 |
| Mean completed telephone calls until understanding changed ± SD | 3.6 ± 1.3 |

## Discussions

Many traditional risk factors for HF-related hospitalization (e.g., diabetes mellitus, New York Heart Association functional class, etc.) have been established; however, we sought to identify simpler, less-invasive risk factors in our patients.[23-27] Higher utilization of primary care visits had an inverse relationship to likelihood of hospitalization and was included in this study to identify patients at increased risk of hospitalization, as discussed above. Although the data were not statistically significant, several additional risk factors were identified: income level, insurance status, number of comorbidities, and gender. This program illustrates the importance of understanding the social determinants of health while developing programs for the chronically ill.

Patient participation was a limitation of this study, with 68 of the 80 high-risk patients being either unable or unwilling to be included in this study. This limited the effectiveness of the study in our clinic as a whole but did provide a proof-of-concept for future programs. The difficulty our group experienced in enrolling patients drives home the importance of discussing critical aspects of self-care during traditional clinic visits or before hospital discharge and enrolling patients in the program at that time. These small numbers also limited the statistical significance of the patient demographics (except the number of clinic visits in relation to hospitalizations), though an easily identifiable risk factor was nonetheless identified for our specific patient population. Additional confounders include the capabilities of each medical student who provided patient education, but this was minimized by providing medical students with a standardized curriculum that had been developed with the assistance of the supervising physician. We were unable to identify a study similar to ours, as many modern population analysis projects rely on large data or meta-analyses to generate statistical significance.

This study is also subject to an inherent selection bias, as those willing to participate in the program may have been more inclined to complete their education and to make positive lifestyle changes, regardless of follow-up calls and reminders from the medical students. If inclusion in the study included the entire HF population of this clinic, this bias may be reduced. In addition, participants in this study had a wide variety of educational backgrounds: some had only completed some secondary education, whereas others had completed postgraduate training.

Despite these limitations, the results of our SHIP program show that establishing a HF-directed constant-contact plan is feasible in a small clinical setting and a unique risk factor may be elucidated for a specific clinic population. The constant-contact program was successful in educating patients on self-management using a standardized curriculum. The duration of the pilot was established taking into account the known fact that high-risk patients with HF are admitted and readmitted to the hospital at a higher rate than patients with other medical conditions. One study showed that patients with HF had a 25% chance of being readmitted to the hospital within 30 days of their most recent hospital discharge.[18] Given that short timeframe, an 8-week duration was chosen for this pilot, to expedite data gathering while also allowing sufficient time to detect re-hospitalization. Given the low number of hospitalizations, this timeframe was likely insufficient to capture enough data to confirm whether the education program was effective in lowering HF-related hospitalizations.

Medical students were the point persons in this study; however, others have reported that trained nursing staff can also carry out regularly scheduled phone calls following hospital discharge.[28-30]

These studies confirm that such programs can help decrease the number of hospital admissions and improve quality of life.

If outreach resources are limited, such programs may improve HF-related care costs in populations without access to "big-data", or whose populations do not fit into larger data analyses by using smaller risk analyses. In addition to the benefit of this program on patients, our program highlights the opportunity to engage medical students in an innovative patient-continuity experience in population health, while simultaneously offering them training on how to develop and implement a Quality Improvement study. This allowed the medical students additional longitudinal patient contact - something of a rarity for many medical students - and provided them concrete feedback that the interventions they advocated were directly benefitting patients.

Future study should involve implementation of such a program on a larger scale to identify statistically significant trends in this population and to validate frequent clinic visits as a risk factor for hospitalization (both initial hospitalizations and hospital readmissions). Once initial lifestyle changes are made, some patients may require additional motivation and support to achieve - and maintain - positive, long-term lifestyle changes, hence engaging HF patients via a constant contact program may prove successful in caring for such patients.

# Original Article

Reichert WB, et al.                                    Student Heart Failure Intervention Pilot: A Study of Risk Factor Analytics and Population Outreach

## References

1. Go AS, Mozaffarian D, Roger VL, Benjamin EJ, Berry JD, Blaha MJ, et al. Heart disease and stroke statistics--2014 update: a report from the American Heart Association. Circulation. 2014 Jan 21;129(3):e28-e292.
2. Lepage S. Acute decompensated heart failure. Can J Cardiol. 2008 Jul;24 Suppl B:6B-8B.
3. Lloyd-Jones D, Adams R, Carnethon M, De Simone G, Ferguson TB, Flegal K, et al. Heart disease and stroke statistics--2009 update: a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Circulation. 2009 Jan 27;119(3):480-6.
4. Writing Group Members, Lloyd-Jones D, Adams RJ, Brown TM, Carnethon M, Dai S, et al. Heart disease and stroke statistics--2010 update: a report from the American Heart Association. Circulation. 2010 Feb 23;121(7):e46-e215.
5. Heidenreich PA, Albert NM, Allen LA, Bluemke DA, Butler J, Fonarow GC, et al. Forecasting the impact of heart failure in the United States: a policy statement from the American Heart Association. Circ Heart Fail. 2013 May;6(3):606-19.
6. Cohen S. Differentials in the concentration of health expenditures across population subgroups in the U.S., 2012: Agency for Healthcare Research and Quality; 2014.
7. Hasselman D. Super-utilizer Summit Common Themes from Innovative Complex Care Management Programs: Center for Health Care Strategies; 2013.
8. Blumenthal D, Chernof B, Fulmer T, Lumpkin J, Selberg J. Caring for High-Need, High-Cost Patients - An Urgent Priority. N Engl J Med. 2016 Sep 8;375(10):909-11.
9. Borde D, Pinkney J, Leverence R. How we promoted sustainable super-utilizer care through teamwork and taking time to listen. N Engl J Med Catalystp. 2016 Aug.
10. Mercer T, Bae J, Kipnes J, Velazquez M, Thomas S, Setji N. The highest utilizers of care: individualized care plans to coordinate care, improve healthcare service utilization, and reduce costs at an academic tertiary care center. J Hosp Med. 2015 Jul;10(7):419-24.
11. Fried LP, Kronmal RA, Newman AB, Bild DE, Mittelmark MB, Polak JF, et al. Risk factors for 5-year mortality in older adults: the Cardiovascular Health Study. JAMA. 1998 Feb 25;279(8):585-92.
12. Krieger N. Racial and gender discrimination: risk factors for high blood pressure? Soc Sci Med. 1990;30(12):1273-81.
13. Lantz PM, Lynch JW, House JS, Lepkowski JM, Mero RP, Musick MA, et al. Socioeconomic disparities in health change in a longitudinal study of US adults: the role of health-risk behaviors. Soc Sci Med. 2001 Jul;53(1):29-40.
14. Meyer IH. Prejudice, social stress, and mental health in lesbian, gay, and bisexual populations: conceptual issues and research evidence. Psychol Bull. 2003 Sep;129(5):674-97.
15. Rozanski A, Blumenthal JA, Davidson KW, Saab PG, Kubzansky L. The epidemiology, pathophysiology, and management of psychosocial risk factors in cardiac practice: the emerging field of behavioral cardiology. J Am Coll Cardiol. 2005 Mar 1;45(5):637-51.
16. Jaarsma T, Halfens R, Huijer Abu-Saad H, Dracup K, Gorgels T, van Ree J, et al. Effects of education and support on self-care and resource utilization in patients with heart failure. Eur Heart J. 1999 May;20(9):673-82.

17. Koelling TM, Johnson ML, Cody RJ, Aaronson KD. Discharge education improves clinical outcomes in patients with chronic heart failure. Circulation. 2005 Jan 18;111(2):179-85.
18. Krumholz HM, Amatruda J, Smith GL, Mattera JA, Roumanis SA, Radford MJ, et al. Randomized trial of an education and support intervention to prevent readmission of patients with heart failure. J Am Coll Cardiol. 2002 Jan 2;39(1):83-9.
19. Ni H, Nauman D, Burgess D, Wise K, Crispell K, Hershberger RE. Factors influencing knowledge of and adherence to self-care among patients with heart failure. Arch Intern Med. 1999 Jul 26;159(14):1613-9.
20. Rich MW, Beckham V, Wittenberg C, Leven CL, Freedland KE, Carney RM. A multidisciplinary intervention to prevent the readmission of elderly patients with congestive heart failure. N Engl J Med. 1995 Nov 2;333(18):1190-5.
21. Stromberg A. The crucial role of patient education in heart failure. Eur J Heart Fail. 2005 Mar 16;7(3):363-9.
22. Yip MP, Chang AM, Chan J, MacKenzie AE. Development of the Telemedicine Satisfaction Questionnaire to evaluate patient satisfaction with telemedicine: a preliminary study. J Telemed Telecare. 2003; 9(1): 46-50.
23. de Lorgeril M, Salen P, Martin JL, Monjaud I, Delaye J, Mamelle N. Mediterranean diet, traditional risk factors, and the rate of cardiovascular complications after myocardial infarction: final report of the Lyon Diet Heart Study. Circulation. 1999 Feb 16;99(6):779-85.
24. Forman DE, Butler J, Wang Y, Abraham WT, O'Connor CM, Gottlieb SS, et al. Incidence, predictors at admission, and impact of worsening renal function among patients hospitalized with heart failure. J Am Coll Cardiol. 2004 Jan 7;43(1):61-7.
25. Giamouzis G, Kalogeropoulos A, Georgiopoulou V, Laskar S, Smith AL, Dunbar S, et al. Hospitalization epidemic in patients with heart failure: risk factors, risk prediction, knowledge gaps, and future directions. J Card Fail. 2011 Jan;17(1):54-75.
26. Kalantar-Zadeh K, Block G, Horwich T, Fonarow GC. Reverse epidemiology of conventional cardiovascular risk factors in patients with chronic heart failure. J Am Coll Cardiol. 2004 Apr 21;43(8):1439-44.
27. Sarnak MJ, Levey AS, Schoolwerth AC, Coresh J, Culleton B, Hamm LL, et al. Kidney disease as a risk factor for development of cardiovascular disease: a statement from the American Heart Association Councils on Kidney in Cardiovascular Disease, High Blood Pressure Research, Clinical Cardiology, and Epidemiology and Prevention. Circulation. 2003 Oct 28;108(17):2154-69.
28. Clark RA, Inglis SC, McAlister FA, Cleland JG, Stewart S. Telemonitoring or structured telephone support programmes for patients with chronic heart failure: systematic review and meta-analysis. BMJ. 2007 May 5;334(7600):942.
29. Shah NB, Der E, Ruggerio C, Heidenreich PA, Massie BM. Prevention of hospitalizations for heart failure with an interactive home monitoring program. Am Heart J. 1998 Mar;135(3):373-8.
30. Wheeler EC, Waterhouse JK. Telephone interventions by nursing students: improving outcomes for heart failure patients in the community. J Community Health Nurs. 2006 Fall;23(3):137-46.