condition. Although fatigue has been noted as a common symptom in HF, there has been limited research measuring the quantitative and qualitative aspects of fatigue in HF. Moreover, relatively few studies have been designed to manage fatigue in HF patients compared to those of cancer-related fatigue. **Objective**: This study aims to analyze the trend of research on management of fatigue for patients with HF and to determine the effects of nonpharmacological interventions through a systematic review and meta-analysis. **Methods**: The databases of MEDLINE, EMBASE, the Cochrane library were systematically explored for eligible studies, using the combinations of MeSH terms, free-text terms, and Boolean operators. The authors independently evaluated the eligibility of the studies published before March 1st, 2018, and extracted the data. The quality assessment was then conducted individually using the Cochrane Collaboration's Risk of Bias Tool. Each of the study results was compared and synthesized using the effect sizes, such as standardized mean difference (SMD), weighted mean difference (WMD) with a 95% confidence intervals (CIs). Heterogeneity was confirmed through the I^2 statistic. **Results**: Eight studies were included-7 were randomized controlled trials; the other was a quasi-experimental study. The types of the interventions involved exercise, education, muscle relaxation, meditation, and biofeedback. The primary outcome was the level of the fatigue measured from the HF patients in the studies. Meta package in R version 3.4.3 was employed to conduct the meta-analysis for the overall 514 participants across the studies. Figure 1 illustrates the forest plot for the results. Random-effects model reveals that nonpharmacological interventions had a significant effect on fatigue in HF patients (SMD = -0.77; 95% CI -1.04 to -0.50). The heterogeneity of the effect sizes was moderately high ($I^2 = 57\%$, $\chi^2 = 0.10$, $p = 0.01$). **Conclusion**: Findings suggest that a nonpharmacological intervention decreases the fatigue in HF population. This calls for more methodological and intervention-driven research devoted to advancing fatigue management programs for the better quality of life of patients with HF.

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What is the Role of Cardiopulmonary Exercise Testing in Goal Directed Therapy of Heart Failure Patients Presenting with Dyspnea

Susie N. Sennhauser[1], Alexandra Sanchez[1], Mauricio Tellez[2,3], John Lee[1], Matthew Lozier[1], Neil Sahni[1], Samantha Molina[4,5], Jillian Mascia[4,5], Gregory Lewis[6], Joshua Larned[7,5]; [1]University of Miami at Holy Cross Hospital, Ft. Lauderdale, FL; [2]El Bosque Escuela Colombiana de Medicina, Bogota, Colombia; [3]Holy Cross hospital, Fort Lauderdale, FL; [4]Holy Cross Hospital, Ft. Lauderdale, FL; [5]Jim Moran Heart and Vascular Research Institute, Fort Lauderdale, FL; [6]Massachusetts General Hospital, Boston, MA; [7]University of Miami at Holy Cross Hospital, ft. lauderdale, FL

Background: Cardiopulmonary exercise testing (CPX) is a non-invasive tool to precisely define maximum exercise capacity with measurement of peak oxygen uptake (pVO$_2$). Combined with other variables, CPX provides a comprehensive characterization of reserve capacity which can then guide the need for treatment. **Purpose**: The purpose of this study was to evaluate findings in ambulatory heart failure patients undergoing CPX and assess heart failure severity/guide treatment. **Methods**: A total of 96 patients were referred to the cardiology service for CPX testing at a local community hospital during the years of 2016 and 2017. All CPX data and results were interpreted/reported by the heart failure medical director. **Results**: Of the 96 patients who underwent CPX testing, 50 were found to have cardio-metabolic impairment due to heart failure (HF). Of these patients, the mean findings were: age 69, BMI 28.6, mean ejection fraction 36.6%, and 35% female. CPX results were notable for average pVO2 of 1.24 L/min (65.85%), average weight adjusted VO2 of 14.56 mL/kg/min (67.76%) and average VE/VCO2 slope of 36.6. 22% of patients were referred to cardiac rehabilitation. 8% were referred to an LVAD/transplant program, while 32% received optimization of medication regimen in the hospital HF clinic. Primary allcause of dyspnea was due to deconditioning (22%) compared to cardiac (30.2%), pulmonary (11.45%) or mixed (27.1%) etiology. 2 patients required the use of inotropes, 4 were readmitted for HF exacerbation and there was 1 recorded death. A total of 40 patients who did not follow up with a provider in our EMR were lost to follow-up. **Discussion**: Using CPX we were able to capture the patients presenting with persistent dyspnea with a component of cardio-metabolic etiology. These patients were then referred to our HF program for further management based on symptomatology and response to therapy. Options for management included the addition/titration of evidence-based HF therapy, cardiac rehab, referral to stage D heart failure centers for evaluation of advanced therapies or intervention. We hypothesize that CPX is a valuable tool to discriminate HF severity in ambulatory patients in a community HF setting. Future directions include using CPX to guide HF management in NYHA I-III patients in HFrEF and HFpEF, and risk prediction of stage C patients based on the ability to identify patients for Stage D intervention versus optimization of medication regimen.

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The Moderating Effect of Social Support in Promoting Self-care in Heart Failure Patients with Comorbid Illnesses

Marguerite Daus, Onome Osokpo, Stacey D. Brown, Barbara J. Riegel; University of Pennsylvania, Philadelphia, PA

Introduction: As the American population ages, patients with heart failure (HF) tend to have more comorbid conditions that make self-care difficult. Prior studies have shown that self-care is worse in HF patients with comorbid conditions but few have examined whether social support compensates for illness complexity. **Hypothesis**: We hypothesized that social support would moderate the relationship between self-care and comorbidities in patients with heart failure. **Methods**: This was a cross-sectional descriptive study of adults hospitalized for a HF exacerbation in one of two hospitals in the northeastern U.S. Adults were eligible if they spoke English, their admitting diagnosis was HF, and they verbally confirmed the diagnosis when approached. Exclusion criteria included dementia and major untreated psychiatric illness. Prior heart transplantation or ventricular assistive device implantation were excluded. All participants provided written informed consent prior to completing a demographic survey and the Self-Care of Heart Failure (SCHFI v7), which measures self-care maintenance, monitoring, and management. Each individual SCHFI scale is scored 0-100 to standardize the score. The number of comorbid conditions was measured by self-report selecting from a list of 18 different disease categories. Social support was measured with a single 4-level item - the higher the score, the better the perceived support. Multiple regression analysis was used to test the moderator effect using the Baron and Kenny method. **Results**: The sample (n=85) was predominantly male (68%), older (62.5 ± 13.5 years), and White (64%); 33% had a high school education or less. Participants had HF for an average of 10.9 (± 12.9) years. The total number of diseases was 4.8 ± 2.2, ranging from 1-10. Self-care maintenance (mean=78.4±15.2), self-care monitoring (mean=73.1±21.1), and self-care management (mean=71.3±17.3) scores were adequate (i.e. >70). The number of comorbidities was significantly related to both self-care maintenance and monitoring (p<0.01) but not management. Social support was not related to maintenance p=0.9, monitoring p=0.1, or management p=0.6 in the first step of the analysis. In the second step, social support significantly moderated the relationship between comorbidities and self-care maintenance (p=0.016) and monitoring (p=0.005). Social support accounted for 6% of the variance in self-care maintenance and 8% of the variance in self-care monitoring. **Conclusion**: Self-care is better in HF patients with comorbid conditions when social support is higher. These complex patients need support from family and friends to assist with self-care.

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Determinants of Depression in Patients with Chronic Heart Failure

Yaewon Seo; University of Texas at Arlington, Arlington, TX

Background: Depressed patients in heart failure (HF) are more susceptible to higher readmission and functional decline. Determinants of depression are unclear and its effective treatments are lacking. The purpose of this study was to examine the effects of dyspnea and social support (SS) from family and friends on depression and functional limitation in chronic HF patients after controlling for effects of age, gender, and co-morbidities. **Methods**: Using a cross-sectional design, a sample of 149 chronic HF patients (NYHA Class II-IV) was recruited at two Midwestern HF clinics. Dyspnea with activities of daily living by a 0-10 visual analogue scale; social support by the multidimensional perceived social support scale; depression by the Beck depression inventory II; and functional limitation by the function subscale of late life function and disability instrument were measured. Data analysis was done using structural equation modeling (SEM). **Results and Conclusions**: Mean age was 57.3 years (SD=13.4; Range 26-88), and about half of the sample was female (n=75) with New York Heart Association functional class II (n=89). The mean depression score was 13.34(SD = 9.89) and half of subjects experienced little or none functional limitation on lower extremities functioning. Nearly 40% of subjects had mild dyspnea with daily activities and majority of subjects reported higher perceived SS from family and friends. χ^2 test (df = 288) = 371.853, comparative fit index = .96, Tucker-Lewis Index = .955, and root mean square error of approximation = .044, suggesting an acceptable model. Dyspnea had direct effects on depression ($\beta = .44$) and functional limitation ($\beta = .68$), whereas social support from friends had an effect on depression ($\beta = -.20$), not social support from family. Patients with less dyspnea and greater friend support had fewer depressive symptoms. Further research is needed to examine whether interventions targeted on managing dyspnea and delivered in a group format improve depression in patients with chronic HF.

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Feasibility of a Novel Virtual Reality-based Cognitive Intervention to Improve Attention in People with Heart Failure

Miyeon Jung[1], Irmina Gradus-Pizlo[2], Marc G. Berman[3], Debra K. Moser[4], Jeff L. Rogers[5], Michael J. Boyles[5], Susan J. Pressler[1]; [1]Indiana University School of Nursing, Indianapolis, IN; [2]University of California, Irvine, CA; [3]University of Chicago, Chicago, IL; [4]University of Kentucky College of Nursing, Lexington, KY; [5]Indiana University, Indianapolis, IN

Introduction: Patients with heart failure (HF) often experience cognitive dysfunction and attention is one of the most commonly impaired cognitive domains. Attention is critical to initiate, maintain, and complete self-care activities effectively. In our previous work, we were able to show some improvements in attention in HF patients with a computer-based natural restorative environment intervention (NRE-C) based on Attention Restoration Theory. Building on that past work, we developed a novel, virtual reality-based, prototype intervention to improve attention by increasing interactions with nature. **Aims**: The aim was to test feasibility (completion, safety, satisfaction, attention improvement) of the virtual reality-based natural restorative

environment intervention (NRE-VR) with enhanced immersiveness. **Methods**: Ten patients with HF (stage C; NYHA Class II/III) were sequentially assigned to the novel NRE-VR (n=5) and then to NRE-C (n=5). NRE-VR included 10 pictures of 360 degree nature views using Gear VR (1 minute/picture, total of 10 minutes), and NRE-C included 50 pictures of 2-dimensional nature views using a laptop computer screen (7 seconds/picture, approximately 7 minutes in total). Attention was examined using Multi-Source Interference Task, Digit Span, Trail Making, and Stroop tests immediately before and after the intervention. Adequacy of HF self-care was examined by the Self-Care of Heart Failure Index at pre-test. **Results**: The sample was 50% female, with a mean age of 59 years, mean of 14 years of education, and mean LVEF of 44%. HF self-care was poor on average (maintenance=63.66 ± 15.67, management=60.00 ± 23.69, confidence=61.16 ± 15.28). Improved performances on the neuropsychological tests of attention were consistently found after NRE-VR except for Digit Span Forward. Compared with NRE-C, NRE-VR group had greater improvements on Multi-Source Interference Task and Trail Making Test (Table 1). All 10 patients completed the study without adverse event. Satisfaction with the intervention was slightly higher among NRE-VR than NRE-C as was enjoyment and immersion. Patients in NRE-C were provided an opportunity to try NRE-VR at the end of the interview and 4 patients tried. All 4 patients preferred having NRE-VR than NRE-C. **Conclusions**: The prototype of NRE-VR was feasible, safe, and demonstrated potential to improve attention among people living with HF.

Table 1. Changes in Attention before and after the Cognitive Interventions (N=10)

Neuropsychological test of attention	Virtual Reality-based Intervention (NRE-VR, n = 5)		Computer-based Intervention (NRE-C, n = 5)	
	Pre-test	Post-test	Pre-test	Post-test
Multi-Source Interference Task				
Congruent, Response time (ms)	792.18 ± 114.49	728.69 ± 107.89	743.63 ± 173.53	765.76 ± 155.93
Congruent, Accuracy (%)	95.77 ± 6.70	99.79 ± 0.46	100 ± 0.00	98.97 ± 0.58
Incongruent, Response time (ms)	1268.90 ± 411.07	1051.62 ± 114.74	968.72 ± 127.38	923.06 ± 125.08
Incongruent, Accuracy (%)	86.20 ± 16.97	96.37 ± 2.96	89.17 ± 12.20	91.67 ± 11.33
Digit Span test				
Forward	5.80 ± 1.30	5.80 ± 0.45	6.40 ± 1.34	6.40 ± 1.82
Backward	4.20 ± 0.84	4.00 ± 0.71	4.80 ± 0.84	5.20 ± 1.10
Trail Making test				
Part A (seconds)	48.90 ± 11.95	37.37 ± 6.33	32.75 ± 10.98	31.35 ± 8.02
Part B (seconds)	110.94 ± 24.18	101.38 ± 27.33	82.25 ± 32.77	90.89 ± 46.77
Stroop test				
Congruent, Response time (ms)	1657.87 ± 313.29	1353.74 ± 455.83	1793.75 ± 999.49	1631.66 ± 968.43
Congruent, Accuracy (%)	95.00 ± 4.56	97.22 ± 3.93	91.67 ± 13.32	98.33 ± 2.49
Incongruent, Response time (ms)	1902.40 ± 437.40	1684.54 ± 563.00	2127.97 ± 1206.70	1783.97 ± 694.59
Incongruent, Accuracy (%)	57.44 ± 9.84	70.56 ± 17.63	70.56 ± 16.38	86.67 ± 10.83

Note. Shorter response times in Multi-Source Interference Task, Trail Making test, and Stroop test indicate better performance. Higher scores on Digit Span test indicate better performance.

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Chief Data Scientist

Sean Pinney[1], Jennifer Ullman[1], Margaret Doll[2], John Donehey[1], Beth Oliver[1], Anu Lala[1]; [1]Icahn School of Medicine at Mount Sinai, New York, NY; [2]RecoverLINK, LLC, New York, NY

Background: Heart failure (HF) remains one of the leading causes of 30-day hospital readmissions. In this study, we examined the feasibility of incorporating Recover-LINK, a digital health technology, into the standard of care for recently discharged HF patients at a large, urban teaching hospital. RecoverLINK supplements transitional care programs by providing outpatients with a 30-day app-based education and intervention program, and delivering analytics to alert providers when an early intervention is needed. **Methods**: We enrolled a convenience sample of 34 HF outpatients to use the RecoverLINK patient app at home for 30-days following a recent discharge, and collected clinical and operational data from the RecoverLINK case manager system as it was used by participating transitional care providers. Feasibility was measured as a function of patient and provider engagement with the technology. We also examined the association between patient engagement with the RecoverLINK app (defined as high, >50% patient-use over 30 program-days, or low, <50% patient-use over 30 program-days) and 30-day hospital readmissions. **Results**: Patients recorded their daily health status in the RecoverLINK app a mean of 58% of program-days, or roughly every other day during the 30-day program (median of 75%). Patient-reported symptoms generated alerts sent to providers via the

RecoverLINK case manager system an average of 9 of 30 (29%) program-days. Providers addressed 100% of alerts, and responded within a median of 3 business days. Among all participants, 15% (95% CI: 6%, 30%) were readmitted within 30-days. Stratified by engagement level, 5% (95% CI: 0%, 23%) of highly engaged Recover-LINK patients (n=1/21) were readmitted within 30-days versus 31% (95% CI: 13%, 58%) of patients with low engagement (n=4/13). **Conclusion**: Patients and providers frequently interacted with the RecoverLINK application, supporting the feasibility of its use as a supplement to HF transitional care programs. Readmissions may be influenced by patient engagement with the RecoverLINK app; however, future research is needed to determine the effectiveness of the application to prevent HF readmissions.

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Effect of Implantable Cardioverter-Defibrillators by Etiology of Heart Failure: A Propensity-Matched Mortality Analysis of the WARCEF Trial

Tetz C. Lee[1], Min Qian[1], Lan Mu[1], Marco R. Di Tullio[1], Susan Graham[2], Dougla L. Mann[3], Koki Nakanishi[1], John R. Teerlink[4,5], Gregory Y.H. Lip[6], Ronald S. Freudenberger[7], Ralph L. Sacco[8], J.P. Mohr[1], Arthur J. Labovitz[9], Piotr Ponikowski[10], Dirk J. Lok[11], Conrado Estol[12], Stefan D. Anker[13,14], Patrick M. Pullicino[15], Richard Buchsbaum[1], Bruce Levin[1], John L.P. Thompson[1], Shunichi Homma[1], Siqin Ye[1]; [1]Columbia University Irving Medical Center, New York, NY; [2]The State University of New York at Buffalo, Buffalo, NY; [3]Washington University School of Medicine, St. Louis, MO; [4]San Francisco Veterans Affairs Medical Center, San Francisco, CA; [5]University of California San Francisco, San Francisco, CA; [6]University of Birmingham, Birmingham, United Kingdom; [7]Lehigh Valley Hospital, Allentown, PA; [8]The University of Miami, Miami, FL; [9]The University of South Florida, Tampa, FL; [10]Military Hospital, Wroclaw, Poland; [11]Deventer Hospital, Deventer, Netherlands; [12]Heart and Brain Medicine, Buenos Aires, Argentina; [13]Charité Universitätsmedizin, Berlin, Germany; [14]University Medicine Göttingen, Göttingen, Germany; [15]Kent Institute of Medicine and Health Science, Canterbury, United Kingdom

Background: There is a recent debate on whether the beneficial effect of implantable cardioverter-defibrillators (ICDs) may be attenuated in patients with non-ischemic cardiomyopathy (NICMP). **Objectives**: We aim to assess whether ICD benefit differs between patients with NICMP and those with ischemic cardiomyopathy (ICMP), using data from the Warfarin versus Aspirin in Reduced Cardiac Ejection Fraction (WARCEF) trial. **Methods**: We performed a post-hoc analysis using the WARCEF trial (N=2293; ICMP, n=991 vs. NICMP, n= 1314), where participants received optimal medical treatment. We developed a propensity score of having an ICD at baseline using 41 demographic and clinical variables, and created 1:2 propensity-matched cohorts for patients with ICD for ICMP (N=223 with ICD; N= 446 matched) and NICMP (N= 195 with ICD; N=390 matched). We constructed Cox proportional hazards model to assess the effect of ICD status on mortality for patients with ICMP and those with NICMP. **Results**: During a median follow-up of 3.5 ± 1.8 years, 527 patients died. Presence of ICD was associated with a lower risk of all-cause death among those with ICMP (HR, 0.64; 95% CI, 0.45 to 0.92; P = 0.01) but not among those with NICMP (HR, 0.98; 95% CI, 0.64 to 1.51; P = 0.94). **Conclusion**: Presence of ICD at baseline conveyed a survival benefit in those with ischemic cardiomyopathy, but not in those with non-ischemic cardiomyopathy.

Kaplan–Meier curves: survival of patients with and without an implantable cardioverter defibrillator.

A. Patients with non-ischemic heart failure B. Patients with ischemic heart failure.
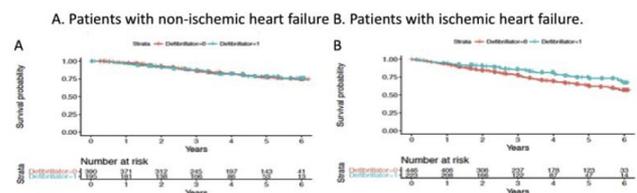
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Knowledge of Exercise Recommendations in Adults with HF

Kristen A. Sethares[1], Nancy M. Albert[2], James Bena[2], Shannon Morrison[2], Rochelle Armola[3], Barbara Riegel[4]; [1]University of Massachusetts Dartmouth, North Dartmouth, MA; [2]Cleveland Clinic, Cleveland, OH; [3]University of Colorado Health System, Colorado Springs, CO; [4]University of Pennsylvania, Philadelphia, PA

Introduction: Moderate-vigorous exercise, an important self-care behavior, is recommended in multiple clinical practice guidelines. In HF, exercise improves clinical outcomes but participation rates are low. Knowledge of exercise and physical activity guidelines may play a role in exercise participation; however, prior studies have included small samples from single sites. The purpose of this study was to determine the relationship between demographic and clinical factors and exercise knowledge levels of patients with HF. **Methods**: This sub-analysis of a multi-site (5 USA and 1 Swedish site) correlational study enrolled a convenience sample. Demographics (gender, age, marital status, ethnicity, highest education, and employment), clinical and HF characteristics (including NYHA class, BMI, depression, comorbidity score, previous cardiac rehabilitation, type of physician seen), past and current participation in physical activity, and knowledge about endurance exercise levels (higher scores