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## A Pilot Randomized Clinical Trial of a Teamwork Intervention for Heart Failure Care Dyads

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## A Pilot Randomized Clinical Trial of a Teamwork Intervention for Heart Failure Care Dyads

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### Abstract

**Background:** Dyadic heart failure (HF) management can improve outcomes for patients and caregivers and can be enhanced through eHealth interventions.

**Objective:** To evaluate the feasibility, acceptability, and preliminary efficacy of an eHealth dyadic teamwork intervention, compared to an attention control condition.

**Methods:** We recruited 29 HF patient-caregiver dyads from inpatient units and randomized dyads to an intervention or a control group. We calculated enrollment and retention rates, described acceptability using interview and questionnaire data, and computed intervention effect sizes.

**Results:** 37% of eligible dyads agreed to participate and 93% of randomized participants completed follow-up questionnaires. Participants found both study conditions to be acceptable. Between-group effect sizes suggested that the intervention led to improvements in relationship quality, self-efficacy, and quality of life for patients and caregivers.

**Conclusions:** Dyadic recruitment from acute care settings is challenging. Findings provide initial evidence that our intervention can contribute to better health outcomes for HF dyads.

### Keywords

Dyadic research; heart failure; family caregivers; behavioral intervention

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None.

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## Introduction

The prevalence of heart failure (HF) in the United States is increasing with approximately 6.2 million Americans currently living with HF.<sup>1</sup> These individuals are recommended to follow a complex self-management regimen and rarely assume self-management alone.<sup>2</sup> Moreover, the trajectory of illness is highly variable and most persons with HF remain in the community through the advanced stages of their disease while receiving assistance from their family caregivers.<sup>3</sup> The central role of family caregivers in the management of HF has been well documented in the literature.<sup>4,5</sup> However, caregivers of persons with HF report poor health-related quality of life, significant stress, deferred self-care, and depression.<sup>6,7</sup> The evidence about self-management complexity and family caregivers' poor health outcomes highlights the need to improve outcomes for both members of the dyad (i.e., the person living with HF and their family caregiver).

Dyadic illness management is a novel behavioral paradigm that focuses on partnerships between individuals with chronic illness and their family caregivers to manage health and illness.<sup>8</sup> In contrast to other health and illness management theories, dyadic illness management focuses on the interdependence in how a person living with a chronic illness and their family caregiver appraise the illness and engage in health promoting behaviors to enhance their health as a dyad.<sup>8</sup> In the context of HF management, dyadic illness management shifts the focus from the conventional paradigm centered around patient behaviors or caregiver contributions, to a dyadic orientation to promote sustained HF management that can result in substantial improvements in the health and well-being of the person with HF and their family caregiver.<sup>8,9</sup> Dyadic HF management is a rapidly emerging area of research that has gained recent attention in the self-management literature. Researchers used qualitative and quantitative methodologies to identify different dyadic care types that exemplify how persons with HF and their family caregivers – the *dyad* – work as a unit to manage HF and improve their quality of life.<sup>10,11</sup>

Dyadic illness management is characterized by illness appraisal and management behaviors that both members of a dyad engage in as a unit to influence dyadic health.<sup>8</sup> Research suggests that greater congruence in the appraisal of care values and preferences as well as shared decision making can lead to better dyadic management behaviors, balancing the needs of both members.<sup>12–15</sup> Moreover, how dyads communicate<sup>14,16,17</sup> and relate to one another<sup>18–21</sup> is posited to contribute to greater dyadic appraisal and more collaborative management behaviors, having lasting effects on the health of patients and their caregivers. Thus, interpersonal communication and relationship quality are modifiable factors that can be a target for intervention to improve dyadic management behaviors, and subsequently dyadic health.

Previous research has long established the role of confidence, or self-efficacy in HF self-management.<sup>22</sup> More recently, Lyons and colleagues<sup>23</sup> examined the concept of dyadic confidence and its influence on engagement in HF management for patients and their spousal family caregivers. Dyadic confidence was operationalized in three ways, by calculating the average score of confidence, the gap in confidence, and the direction of

the gap within each dyad. A greater dyadic average confidence was associated with better self-management for the person with HF. Moreover, a larger gap in confidence scores between patients and their spouses, indicating incongruence in confidence, was associated with less spousal engagement in HF management. Given the lack of a gold-standard measure of dyadic HF management, the engagement of both members of a dyad in HF management can be considered an indicator of dyadic HF management. Therefore, dyadic confidence is an influential contributor to dyadic HF management.<sup>23</sup> It is important to focus on improving confidence, or self-efficacy for both members of the dyad while decreasing the gap between self-efficacy levels for the person with HF and their family caregiver.

Based on a recent systematic review, few dyadic HF interventions had sustained effects on patient and caregiver outcomes.<sup>24</sup> Additionally, few investigators used electronic health (eHealth) technology to deliver their interventions.<sup>24</sup> Dyadic HF management can be enhanced through eHealth interventions, which are emerging as an acceptable and efficient alternative to in-person, clinician- or paraprofessional-delivered interventions. A preponderance of eHealth interventions to improve HF management has solely focused on the patient, missing the opportunity to engage family caregivers.<sup>25–27</sup> Yet, there is promising evidence to support the feasibility of eHealth dyadic interventions and their initial efficacy on dyadic illness management, and patient and caregiver outcomes, such as self-efficacy and quality of life.<sup>28</sup>

The evidence base on efficacious interventions to improve dyadic HF management is relatively nascent and, given the paucity of interventional research, rigorous clinical trials are needed to support dyads living with HF. To address the current need for interventional research focused on dyadic HF management, we conducted a pilot study of a dyadic eHealth intervention, eSMART-HF (electronic Shared Management and Relationship Training for Heart Failure). eSMART-HF focused on enhancing teamwork skills for dyadic HF management and encouraged persons with HF and family caregivers to explore areas for improved communication and mutual support.

The purpose of this article is two-fold. First, we will report the feasibility and acceptability of administering two eHealth experimental conditions (eSMART-HF vs. screen-based education) in a dyadic context. Secondly, we provide preliminary data on the effects of eSMART-HF compared with a screen-based educational condition on measures of communication, decision making, relationship quality, self-efficacy, and quality of life among dyads of persons with HF and their family caregivers. The eSMART-HF condition was designed to focus on dyadic illness management by promoting goal setting, interpersonal communication, and relationship quality within each dyad. Therefore, we posited that participants exposed to eSMART-HF will demonstrate better communication, decision making, relationship quality, self-efficacy, and quality of life, compared to those randomly assigned to screen-based education.

## Methods

### Design

This is a two-arm randomized, pilot clinical trial of eSMART-HF compared to an attention control condition (screen-based education [SBE]). A nonprobability sample of patient-family caregiver dyads was recruited from a large academic medical center and data were collected at baseline and one-week post-intervention. All study procedures were approved by the University Hospitals Institutional Review Board.

### Participants

Patients were eligible if they: (a) were diagnosed with HF, (b) were hospitalized for a HF exacerbation and planned for a home discharge, and (c) had a co-residing family caregiver. Patients were excluded if they had: (a) an implanted left ventricular assist device or implant anticipated in <3 months, (b) a history of heart transplant or were actively listed for heart transplant, (c) a referral to hospice or extended rehabilitation care, (d) a history of cognitive impairment, (e) a planned cardiac surgery, or (f) a family caregiver who does not agree to participate. Eligible family caregivers had to be living with the patient and assisting them with care needs. Both members of the dyad had to be  $\geq 18$  years old, able to speak and understand English, and able to view images and text on an 8-inch screen and hear audio through a standard headset.

### Procedures

**Recruitment**—Participants were recruited between February 2019 and February 2020 from inpatient units at a large academic medical center. The stepwise recruitment of dyads started by identifying eligible patient participants through daily screening of the electronic medical record. The research team approached eligible patients at the hospital for in-person screening and study introduction. Interested patients who agreed to participate signed the informed consent document and received a study brochure to discuss the opportunity with their primary family caregiver, defined as the primary person involved in their care.

The research team also attempted to meet the caregiver in person at the hospital to introduce the study. If the caregiver was not available for an in-person meeting, screening and recruitment of family caregivers was initiated over the phone and completed during the first home visit.

**Randomization**—Following informed consent, dyads were randomly assigned with 1:1 allocation to either the eSMART-HF intervention or an attention control condition using a web-based application. Randomization was stratified by relationship type to account for potential differences in dyads with spousal versus non-spousal caregivers.

**Experimental Conditions**—Participants in both groups had access to four consecutive sessions lasting 10–15 minutes each and were instructed to complete one session every week over four weeks. The content of the sessions varied based on group assignment and was tailored to the participant's role (patient vs. caregiver). Therefore, patient participants and family caregiver participants had access to separate sessions. Participants were able to

review the completed sessions throughout the period of the study. During the first home visit, each dyad received one tablet computer and was instructed on its usage to access the App-based sessions. All participants received weekly reminder phone calls or text messages to enhance their use of the tablets, but the topics of the sessions were not discussed over the phone.

The *eSMART-HF intervention* was guided by two theoretical frameworks from the field of organizational behavior – relational coordination theory<sup>29</sup> and high-quality connections framework<sup>30</sup> – and by the theoretical underpinnings of social cognitive theory.<sup>31</sup> According to the theory of relational coordination, interdependent work is most effectively achieved through relationships of shared goals, shared knowledge and mutual respect, and is supported by frequent, timely, accurate, problem-solving communication. Similarly, high-quality connections are positive interactions characterized by cognitive, emotional, and behavioral processes that can improve individual and collective functioning. Therefore, the guiding frameworks are well-aligned with the theory of dyadic illness management and highlight various cognitive, emotional, and behavioral mechanisms that facilitate teamwork and enable dyads to share goals and knowledge, engage in optimal communication, and display mutual support and respect.

Participants randomized to eSMART-HF were exposed to four interactive sessions consisting of didactic presentations coupled with experiential exercises accessed through a supplemental printed workbook. Patient and caregiver participants received separate workbooks and were encouraged to use them along with the sessions. Throughout the sessions, participants were presented with examples and situations relevant to the management of HF in a dyadic context. The content of the sessions was developed by a team of nurse scientists with expertise in decision making, cardiovascular care, and caregiving, in consultation with an organizational psychologist and a cardiologist.

In the first session (“setting shared goals”), patients and family caregivers reflected on how they functioned as a team and were guided to develop an action plan to better manage HF and improve both of their well-being. Session 2 (“communicating timely, accurately, and effectively”) focused on training dyads in communication skills that aid in developing problem-solving and decision-making skills. In session 3 (“managing emotions”), participants learned how to be aware of and how to manage emotions that affect the well-being of their loved ones. In the last session (“enhancing mutual respect and assessing progress”), participants learned how to express appreciation towards their loved ones and were guided to revisit their action plans. Although patients and caregivers had access to separate sessions, they were encouraged to discuss their goals and progress with each other at regular time points and practice the strategies in the week following each session.

The *attention control condition*, SBE, is an enhancement to usual care. In addition to their regular scheduled contact with their healthcare team, dyads randomly assigned to this condition had access to four consecutive educational sessions developed from materials authored by the Heart Failure Society of America and American Heart Association. The sessions covered the following topics: (1) symptom management, (2) healthy eating choices,

(3) healthy lifestyle changes, and (4) medication management. In contrast to participants randomized to the eSMART-HF intervention, those in the attention control group did not receive training on how to function as a team and did not have access to the workbook. Additionally, the content of the control sessions was developed without incorporating the behavior change techniques used in the intervention condition, such as goal setting, action planning, and providing general encouragement. This attention control condition allowed to control for the novelty and potential added effect of technological enhancement on intervention uptake and outcomes.

**Data Collection and Measures—**The research team conducted home visits within one week of hospital discharge to complete baseline data collection, and one week post-intervention to collect follow up data. Participants answered survey questions independently on a tablet computer. Each participant received a \$15 gift card at the first visit and a \$25 gift card at the end of the study as compensation for their time.

Participants completed a demographic questionnaire at baseline. Depressive symptoms of patients and caregivers were assessed using the Patient Health Questionnaire (PHQ)-8.<sup>32,33</sup> Patient comorbidity was assessed using the Charlson Comorbidity Index<sup>34</sup> and other clinical data were abstracted from the electronic medical record. Demographic and clinical data were used to characterize the sample.

**Feasibility.:** Participant recruitment and retention were tracked and reasons for refusal and dropout were captured in order to assess the feasibility of recruiting dyads for an intervention study. Feasibility of the electronic delivery method was also assessed by documenting session completion rates, frequency of viewing each session, and use of the eSMART-HF workbook.<sup>35</sup>

**Acceptability.:** At the end of the study, participants completed an investigator-developed acceptability questionnaire about the content and format of the sessions. They rated the usefulness of the program and their comfort with the technology on a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*). They also participated in a semi-structured interview to describe their experience in the program and their experience using the tablet device. Participants were asked about what they liked and disliked about the sessions and the App. They were also invited to share their ideas to improve the content of the program as well as their overall experience. Both members of the dyad were present at the time of the interview and questions were tailored to group assignment to facilitate the discussion.

**Efficacy.:** Both members of the dyad completed the following self-report questionnaires at baseline and one week following the final intervention session. Scale ranges and internal consistency levels are presented in Tables 3 and 4.

*Communication* and *decision making* were measured using the patient and caregiver versions of the Shared Care Instrument (SCI-3), which consists of 3 subscales to assess communication (5 items), decision making (6 items), and reciprocity (8 items).<sup>36</sup> Participants rated their agreement with each question on a 6-point Likert scale. Sum scores were computed for each subscale separately, with higher scores reflecting better



communication, decision making, and reciprocity for each member of the dyad. The instrument was previously administered to patients with HF and their family caregivers and demonstrated good reliability for all subscales, with Cronbach's alpha ranging from .69 to .85 for patients and .72 to .90 for caregivers.<sup>12,36</sup>

*Relationship quality* was assessed using 8-item reciprocity subscale of the SCI-3 (as described above) and the 15-item Mutuality Scale that evaluates the extent to which a relationship is characterized by emotional investment and mutual support.<sup>37</sup> All participants completed each item of the Mutuality Scale on a scale from 0 (*not at all*) to 4 (*a great deal*) and total scores were calculated using the mean of all item scores, with higher scores reflecting better relationship quality. The Mutuality Scale is widely used in diverse samples of patients and family caregivers and has demonstrated excellent internal consistency in patients with HF and their family caregivers, indicated by Cronbach's alpha of .90–.95.<sup>21,38</sup>

*Heart failure self-efficacy* was measured using the 6-item self-care confidence scale of the Self-care of Heart Failure Index (SCHFI) v.6.2 (for patients)<sup>39</sup> and the Caregiver Contributions to SCHFI v.1 (for caregivers).<sup>40</sup> Using a 4-point Likert scale (1 = *not confident* to 4 = *extremely confident*), patient participants rated their confidence in managing HF, while caregiver participants rated their confidence to help patients manage HF. Total scores were calculated and standardized for each scale, with higher scores reflecting higher self-efficacy. Both the patient and caregiver self-confidence scales demonstrated good internal consistency using a variety of indices (ranged from .84 to .90 for patients and was .72 for the caregiver's scale) and test-retest reliability.<sup>40,41</sup>

*Health-related quality of life* was assessed for all participants using the Patient-Reported Outcome Measurement Information System (PROMIS) Global Health Measure v.1.2, which was validated against EuroQOL-5D and demonstrated excellent internal consistency.<sup>42</sup> This measure includes 10 items that assess generic health-related quality of life compared to the general population. Nine of 10 questions are rated on 5-point Likert scales and the last question is answered using a numeric scale. Standardized physical and mental health scores were generated from 4 items each using the HealthMeasures Scoring Service, with higher scores reflecting better physical and mental health.

**Data Analysis**—Descriptive statistics were used to characterize the sample. Recruitment feasibility was assessed using descriptive statistics to report the rates of consent, refusal, and attrition. To assess the feasibility of the delivery method, App usage data were extracted from the tablet devices at the end of the study and rates of session completion were calculated to specify participant's duration of exposure to a study condition. Acceptability data from the investigator-developed questionnaire were summarized using descriptive statistics. Then the recordings of the semi-structured acceptability interviews were transcribed verbatim and analyzed using content analysis to explore participants' experiences with the study and their recommendations about the sessions. The coded transcripts were reviewed by a member of the research team and findings were discussed to reach consensus. An audit trail was kept to document the details of data analysis, including the decisions that led to the findings.

To assess the preliminary efficacy of the intervention, pre-intervention to post-intervention change scores were calculated for each participant, and then between-group effect sizes (Cohen's  $d$ ) were calculated. Effect sizes were classified as small (.20), medium (.50), and large (.80).<sup>43</sup> Given the exploratory nature of the study and the small sample size, significance tests were not calculated for between-group comparisons on the outcome variables. According to the American Statistical Association guidelines,<sup>44</sup> we should not focus on the  $p$ -values but the effect sizes for an expected signal of the intervention effects.

## Results

### Participants

Table 1 presents the demographic and clinical characteristics of the participants. Most patients were male (64.3%), non-employed (75%), and married or in a relationship (60.7%). Caregivers were younger than patients, mostly female (78.6%), and were the patient's spouse or partner (60.7%). The racial distribution of our sample is different from other samples reported in the HF self-management literature, with most patients (67.9%) and caregivers (71.4%) self-identifying as Blacks. The intervention and control groups were similar on all patient and caregiver characteristics, except for caregiving hours. Family caregivers randomized to the control group reported a greater number of hours spent on caregiving activities compared to those in the intervention group ( $t(14.63) = 1.96, p = .070$ ). There were modest between-group differences at baseline in two outcome measures for family caregivers. Those randomized to the control group had higher self-efficacy ( $t(26) = 1.99, p = .057$ ) and better mental quality of life ( $t(26) = 1.86, p = .074$ ) at baseline compared to those in the intervention group.

### Feasibility of the Recruitment Protocol

Of the 742 patients screened, 641 (86.4%) were excluded (Figure 1). Common reasons of exclusion included not having a HF diagnosis (19.5%), a caregiver (13.9%), or a co-residing caregiver (11.2%), and being scheduled for a cardiac surgery (9.7%). Of the 101 eligible dyads, 10 were lost to follow up after discharge and 37 dyads agreed to participate. Reasons for refusal included not being interested (61.1%) and feeling overwhelmed (20.4%). In a few cases, refusals came solely from the caregiver (11.1%). Following enrollment, 8 dyads withdrew from the study before randomization because the patient's condition deteriorated ( $n = 6$ ) or they were no longer interested ( $n = 2$ ). Twenty-nine dyads were randomized to the control group ( $n = 13$ ) or eSMART-HF ( $n = 16$ ). One dyad, one patient and one caregiver (belonging to different dyads) dropped out due to health complications. All analyses are based on the 27 patients and 27 caregivers who provided baseline and follow-up data.

### Feasibility of the eHealth Delivery Method

Half of the participants in each of the two groups adhered to the protocol in terms of completing one session per week and the majority viewed each session once. All patients and most (12 of 13, 92.31%) caregivers assigned to the control group completed all four sessions, whereas those assigned to eSMART-HF had varied rates of completion, with session 4 being the least completed session by patients ( $n = 12, 80%$ ) and caregivers ( $n = 10,$

71.43%). Half of the participants in the intervention group indicated using the workbook at some point during the study, with no difference between patient and caregiver participants.

Among the 28 dyads who remained in the study, four dyads completed the sessions together, three completed some sessions together, and the majority ( $n = 21$ , 75%) always logged in individually. These findings were similar across groups.

### Acceptability

Most caregivers (96.4%) and patients (71.4%) expressed a general comfort regarding the use of technology, with no group differences. The majority of caregivers (96.3%) and patients (92.6%) owned a smartphone or tablet computer. Many participants (57.1%) did not need assistance using the tablet. In some cases (32.1%), caregivers helped patients access the sessions. Participants rated eSMART-HF and the SBE as easy to use and understand (see table 2). The ratings were similar regardless of participant role or group assignment with one exception. Caregivers assigned to SBE reported a higher level of comfort using the tablet compared to those receiving eSMART-HF ( $t(25) = 2.38$ ,  $p = .03$ ).

We will present the qualitative acceptability findings for participants in the eSMART-HF group to summarize their experiences and recommendations to improve the intervention program. During the acceptability interview, participants expressed a general satisfaction with the eSMART-HF sessions and reported engaging in an open discussion with their loved one. One caregiver participant explained: “I found the first section very helpful; it gave me permission to let him know what I’m thinking.” Other participants indicated that the content of the intervention facilitated their communication around HF management and improved their emotional responses to one another. One caregiver participant said: “I liked it because it taught you insight about how you can treat your partner, and it gives you more information about how to be sensitive to her feelings.” Some patients indicated that the sessions supplemented the information they have received from their providers by focusing on their relationship with their family member to make health decisions. Participants provided recommendations to improve the intervention by incorporating additional real-life scenarios and making the App more interactive. Lastly, there was a mixed response about the use of the workbook, with some valuing the experience of writing their thoughts while others preferring to keep all activities embedded in the App.

### Preliminary Efficacy

Mean scores on outcomes and intervention effect sizes for patients and family caregivers are presented in tables 3 and 4. We found small to medium effect sizes in favor of the intervention for patients and family caregivers. Patients receiving the intervention had a tendency for improvement in decision making, relationship quality, self-efficacy, and quality of life, compared to those in the attention control group. Family caregivers receiving the intervention had a tendency for improvement in their relationship quality, self-efficacy, and quality of life, compared to those in the control group. A large effect size was identified for caregivers’ mental quality of life.

## Discussion

In this pilot study, we tested the feasibility, acceptability, and preliminary efficacy of an eHealth teamwork intervention for dyadic HF management developed based on social cognitive theory and teamwork principles derived from the organizational behavior literature. The goal of the intervention was to promote collaboration among adults with HF and their family caregivers. Our findings provide preliminary support for the feasibility and acceptability of the intervention, and demonstrate its potential benefits for patients with HF and their family caregivers. Results suggest the value of revising the eHealth dyadic teamwork intervention before testing it in a larger randomized-controlled trial.

In terms of recruitment feasibility, our low enrollment rates reflect the challenges associated with recruiting HF care dyads from inpatient units. Other researchers have identified barriers to the recruitment of adults with acute HF.<sup>45</sup> Our team made several changes to the recruitment protocol to address initial challenges. Nevertheless, our enrollment rate remained low throughout the study, which is similar to what other dyadic researchers have reported when working with dyads managing acute or critical illnesses.<sup>46,47</sup> Recruitment of dyads is more complex than the separate recruitment of patients and family caregivers because both members of the dyad are required to agree to participate. Future investigations need to consider the complexity of dyadic recruitment from acute care settings. In addition to the short length of stay for HF treatment, patients may have other priorities while in the hospital and family caregivers may not always be available for study introduction. Therefore, there is a need to expand the recruitment of dyads to several clinical sites, including outpatient clinics.

Participants had favorable ratings for the use of the tablet computer and appreciated the topics covered during the intervention sessions. Our acceptability findings support the adoption of technology for intervention delivery and monitoring with dyads. Based on a recent systematic review, technology-based interventions targeting dyads are feasible and acceptable.<sup>28</sup> Other investigators testing technology-based dyadic interventions have used technologies with varying levels of complexity. Many of our participants wished for a greater level of interaction with the tablet computer and recommended incorporating a great number of activities into the App. Additional research is needed to determine the ideal technology that would promote collaboration among dyads and facilitate their discussion about shared HF management.

Another area of intervention delivery that requires further attention is whether dyads need to participate in the intervention sessions together. In our study, participants appreciated the flexibility of completing sessions at different times from their partners, and many commented that this factor contributed to the feasibility of the study. In other technology-based dyadic interventions, dyad members participated in the sessions together if the intervention was delivered via videoconference,<sup>48,49</sup> or had the option to access the materials independently of each other through a website.<sup>50,51</sup> While it is important to maintain the convenience and flexibility associated with the use of technology, participants may benefit from completing specific intervention activities together.

Regarding the efficacy of the intervention, the between-group effect sizes suggest that dyads in the eSMART-HF group had a tendency for improvement in relationship quality, self-efficacy, and quality of life for both members of the dyad. However, our intervention had a stronger effect on caregivers' outcomes for the most part. Other investigators used similar strategies to improve communication and foster teamwork among couples managing cancer.<sup>49,50</sup> Unlike our findings, Porter et al.<sup>49</sup> found that patients benefited more than their partners on measures of relationship functioning (i.e., satisfaction, intimacy, and communication), whereas Song et al.<sup>50</sup> found that patients had a greater improvement in quality of life compared to their partners. In our study, we did not solely recruit couples managing HF. Other types of relationship within a dyad may have influenced how our participants responded to the intervention. Additional work is needed to identify the optimal dose of the intervention to have adequate and sustainable effects on outcomes for both members of the dyad, while taking into consideration their relationship type.

Our findings have important research and practice implications. It will be important to explore factors that contribute to the differential effect of dyadic interventions on each member of the dyad in order to tailor interventions accordingly. Our next step is to revise the intervention based on participants' feedback and conduct further testing of the intervention. One area for improvement is the adoption of a more interactive interface that would help participants relate to the recommended strategies and would facilitate a discussion within the dyad. In terms of practice implications, our findings highlight the role of nurses across clinical settings in applying teamwork principles to foster collaboration among persons with HF and their family caregivers on health management. Nurses are uniquely positioned to help patients and their family caregivers function as a team while co-managing health conditions to improve health outcomes. By furthering interventions focused on the dyadic management of HF, nurses will be able to support patient and caregiver needs more holistically.

Our study has several limitations. First, our sample may not be representative of the broader population of dyads managing HF. While we focused on co-residing caregivers, 11% of screened patients had a family caregiver who did not live with them and were not eligible to participate. Moreover, patients and family caregivers who agreed to participate may have a better relationship compared to those who refused participation or were lost to follow up. Second, the exploratory nature of the study and the small sample size limit our ability to make definitive conclusions about intervention effects. Additionally, there were marginally significant differences at baseline between the two groups in caregivers' self-efficacy and mental quality of life. These differences may have influenced the effect size of the intervention given the potential for ceiling effect in the control group. Lastly, our assessment of outcome data was limited to the immediate period following intervention completion. Therefore, future testing needs to include a larger sample size and additional data points to assess the long-term effects of the intervention and identify strategies to sustain those effects.

In conclusion, the findings of this pilot study provide initial evidence for the feasibility of enrolling HF care dyads in an intervention study after modifying the recruitment protocol. Participants confirmed that what was asked of them is manageable and practical,

and provided recommendations to improve the delivery of the intervention. Moreover, preliminary efficacy findings suggest that our intervention shows promise in enhancing patients' and caregivers' self-efficacy and mental well-being, as well as dyads' relationship functioning. Future steps include revising the study protocol and intervention delivery in order to conduct further testing of the intervention in a larger clinical trial.

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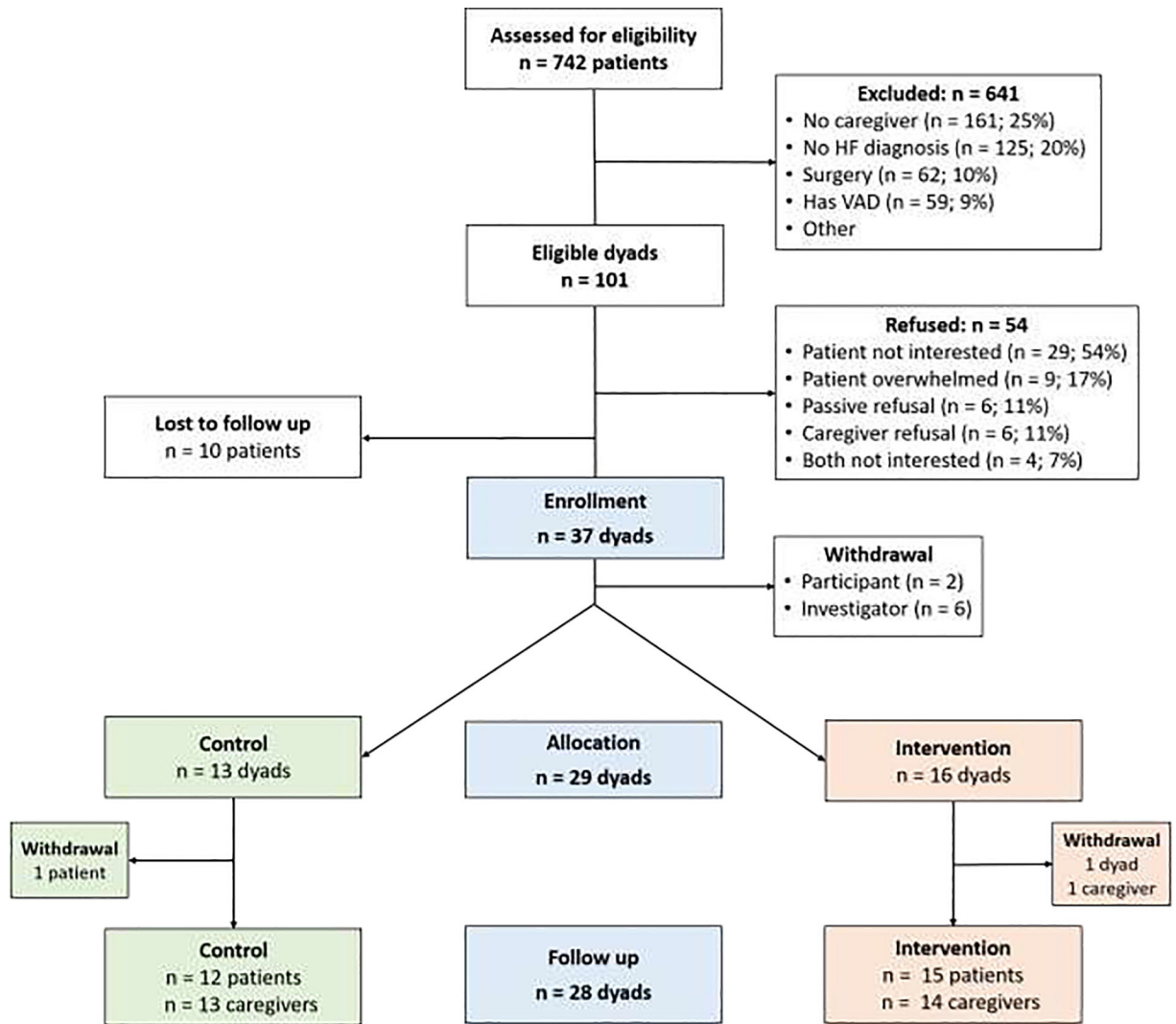
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### Highlights

- eHealth interventions for heart failure care dyads are feasible and acceptable
- Our teamwork intervention can improve outcomes for both members of a dyad
- Recruiting dyads from acute care settings for intervention research is challenging



**Figure 1:**  
Study consort diagram

**Table 1.**

## Demographic and clinical characteristics

<b>Variable</b>	<b>Patients <i>n</i> (%) or mean <math>\pm</math> SD</b>	<b>Family caregivers <i>n</i> (%) or mean <math>\pm</math> SD</b>
<b>Age (in years)</b>	62.57 $\pm$ 11.54	50.21 $\pm$ 20.04
<b>Gender</b>		
Female	10 (35.7)	22 (78.6)
Male	18 (64.3)	6 (21.4)
<b>Race</b>		
Non-White	20 (71.4)	21 (75)
White	8 (28.6)	7 (25)
<b>Marital status</b>		
Not Married	11 (39.3)	9 (32.1)
Married/Partnered	17 (60.7)	19 (67.9)
<b>Education</b>		
High school or less	17 (60.7)	18 (64.3)
> High school degree	11 (39.3)	10 (35.7)
<b>Employment status</b>		
Non-Employed	21 (75)	14 (50)
Employed	7 (25)	14 (50)
<b>HF type</b>		
HFrEF	17 (60.7)	
HFpEF	11 (39.3)	
<b>NYHA class</b>		
Class I	7 (25)	
Class II	2 (7.1)	
Class III	13 (46.4)	
Class IV	6 (21.4)	
<b>Years since HF diagnosis</b>	9.36 $\pm$ 8.76	
<b>Charlson Comorbidity Index</b>		
Low (1–2)	3 (10.7)	
Moderate (3–4)	6 (21.4)	
High ( $\geq$ 5)	19 (67.9)	
<b>Hospital length of stay (in days)</b>	5.54 $\pm$ 4.61	
<b>Relationship type</b>		
Non-Spouse		11 (39.3)

<b>Variable</b>	<b>Patients <i>n</i> (%) or mean <math>\pm</math> SD</b>	<b>Family caregivers <i>n</i> (%) or mean <math>\pm</math> SD</b>
Spouse/Partner		17 (60.7)
<b>MoCA (0–30)</b>	23.79 $\pm$ 2.71	24.71 $\pm$ 3.29
<b>Depressive symptoms: PHQ-8</b>	7.57 $\pm$ 4.86	4.75 $\pm$ 5.50
<b>Years as caregiver</b>		10.45 $\pm$ 11.71
<b>Relationship years</b>		31.74 $\pm$ 15.48
<b>Co-residence years</b>		27.23 $\pm$ 16.97
<b>Caregiving hours per week</b>		33.52 $\pm$ 39.03
<b>Attend healthcare appointment</b>		
Occasionally		11 (39.3)
Often		7 (25)
Almost all the time		10 (35.7)

*Note.* HFrEF = heart failure with reduced ejection fraction; HFpEF = heart failure with preserved ejection fraction; NYHA class = New York Heart Association class; MoCA = Montreal Cognitive Assessment.

**Table 2.**

Acceptability of the electronic delivery method among patients and family caregivers

	eSMART-HF		SBE	
	Patients ( <i>n</i> = 15)	Family Caregivers ( <i>n</i> = 14)	Patients ( <i>n</i> = 12)	Family Caregivers ( <i>n</i> = 13)
<b>I found the program useful</b>	4.13 (0.83)	4.36 (0.5)	4.5 (0.52)	4.31 (1.03)
<b>The content was clear</b>	4.47 (0.52)	4.57 (0.51)	4.67 (0.49)	4.69 (0.48)
<b>The terminology and text were concise and easy to understand</b>	4.6 (0.51)	4.5 (0.52)	4.67 (0.49)	4.77 (0.44)
<b>I felt comfortable using the tablet computer</b>	4.6 (0.51)	4.36 (0.84)	4.58 (0.52)	4.92 (0.28)
<b>The “app” on the tablet computer was easy to navigate</b>	4.67 (0.49)	4.43 (0.85)	4.67 (0.49)	4.92 (0.28)
<b>The “app” had a pleasing color scheme and style</b>	4.67 (0.49)	4.64 (0.5)	4.58 (0.52)	4.85 (0.37)
<b>Overall, I was satisfied with the program</b>	4.6 (0.51)	4.79 (0.43)	4.75 (0.45)	4.54 (0.66)

*Note.* The data are presented as means (with standard deviations in parentheses). Items were rated 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*).

eSMART-HF: electronic Shared Management and Relationship Training for Heart Failure care dyads, SBE: Screen-Based Education.

**Table 3**

Means, standard deviations, and effect sizes of outcome variables for patients

	Scale Range	Alpha	eSMART-HF			SBE			Effect size
			<i>n</i>	Pre <i>M (SD)</i>	Post <i>M (SD)</i>	<i>n</i>	Pre <i>M (SD)</i>	Post <i>M (SD)</i>	
Communication	0–95	.684	15	16.07 (6.23)	19.40 (4.76)	12	14.85 (5.81)	18.42 (4.19)	–0.02
Decision making	0–95	.923	15	22.53 (6.86)	23.67 (6.86)	12	23.62 (6.79)	24.33 (3.60)	0.35
Reciprocity*	0–95	.764	15	32.47 (5.59)	33.80 (5.05)	12	35.31 (3.99)	34.92 (3.20)	0.59
Mutuality*	0–4	.954	15	3.48 (0.54)	3.54 (0.59)	12	3.46 (0.64)	3.37 (0.56)	0.36
Heart failure self-efficacy	0–100	.859	15	72.56 (14.68)	76.73 (13.26)	12	71.85 (18.27)	74.37 (11.50)	0.29
Quality of life (physical)		.637	15	37.42 (6.74)	39.79 (8.10)	12	38.56 (10.42)	39.05 (9.72)	0.34
Quality of life (mental)		.614	15	44.02 (8.52)	44.81 (6.60)	12	48.25 (6.86)	45.28 (6.98)	0.47

Note.

\* Reciprocity and mutuality were indicators of relationship quality.

eSMART-HF: electronic Shared Management and Relationship Training for Heart Failure care dyads, SBE: Screen-Based Education.

**Table 4**

Means, standard deviations, and effect sizes of outcome variables for family caregivers

	Scale Range	Alpha	eSMART-HF			SBE			Effect size
			<i>n</i>	Pre <i>M (SD)</i>	Post <i>M (SD)</i>	<i>n</i>	Pre <i>M (SD)</i>	Post <i>M (SD)</i>	
Communication	0–95	.858	14	14.00 (6.44)	15.57 (6.07)	13	11.23 (7.41)	14.92 (8.86)	–0.33
Decision making	0–95	.873	14	23.67 (4.93)	24.93 (3.38)	13	22.08 (7.26)	23.38 (6.51)	–0.28
Reciprocity*	0–95	.808	14	32.80 (5.86)	35.71 (3.45)	13	35.69 (6.10)	35.54 (5.04)	0.71
Mutuality*	0–4	.957	14	3.20 (0.78)	3.34 (0.61)	13	3.50 (0.61)	3.41 (0.83)	0.46
Heart failure self-efficacy	0–100	.937	13	71.72 (20.50)	76.66 (12.57)	13	85.00 (16.73)	83.40 (16.85)	0.28
Quality of life (physical)		.706	14	44.21 (9.45)	47.91 (8.95)	13	46.79 (9.71)	47.8 (9.53)	0.29
Quality of life (mental)		.861	14	43.46 (7.94)	50.3 (8.76)	13	50.35 (10.37)	49.01 (9.99)	0.85

Note.

\* Reciprocity and mutuality were indicators of relationship quality.

eSMART-HF: electronic Shared Management and Relationship Training for Heart Failure care dyads, SBE: Screen-Based Education.