Title

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e-Care for Heart Wellness:

A Feasibility Trial to Decrease Blood Pressure and Cardiovascular Risk

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Abstract

Background—Pharmacist- or nurse-led team care decreases patient blood pressure (BP) and cardiovascular disease (CVD) risk.

Purpose—To evaluate whether a Web-based dietitian-led (WD) team care intervention was feasible and resulted in decreased BP, CVD risk, and weight compared to usual care (UC).

Methods—Electronic health record (EHR) data identified patients aged 30–69 years with BMI>26, elevated BP, and 10%–25% 10-year Framingham CVD risk who were registered patient website users. Patients with uncontrolled BP at screening were randomized to UC or WD, which included a home BP monitor, scale, and dietitian team care. WD participants had a single in-person dietitian visit to obtain baseline information and create a plan to reduce CVD risk.. Planned follow-up occurred via secure messaging to report BP, weight, fruit and vegetable intake, and receive ongoing feedback. If needed, dietitians encouraged patients and their physicians to intensify antihypertensive and lipid-lowering medications. Primary outcomes were change in systolic BP and weight loss ≥4 kg at 6 months. Feasibility outcomes included intervention utilization and satisfaction.

Results—Between 2010 and 2011, 90 of 101 participants completed 6-month follow-ups. The WD group had higher rates of secure messaging utilization and patient satisfaction. The WD group lost significantly more weight than the UC group (adjusted net difference= −3.2 kg [95% CI= −5.0, −1.5], $p<0.001$) and was more likely to lose ≥4 kg (adjusted relative risk [RR_{adj}]=2.96 [95% CI=1.16, 7.53]). BP control and CVD risk reduction were greater in WD than UC, but differences were not statistically significant.

Conclusions—WD intervention was feasible and resulted in decreased weight, BP, and CVD risk. A larger trial is justified.

Introduction

Lifestyle changes, including weight loss and the Dietary Approaches to Stop Hypertension (DASH) diet,[1-3] are recommended as effective strategies for reducing blood pressure (BP) and cardiovascular disease (CVD) risk. However, less is known regarding how to integrate these lifestyle interventions into clinical care. The U.S. Preventive Services Task Force

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found adequate evidence that high-intensity, multicomponent behavioral lifestyle counseling interventions provided in clinical settings (directly or by referral) improve BP and lipid profiles, as well as diabetes control[4] and weight loss (both B recommendations).[5] In addition, the U.S. Community Preventive Services Task Force found strong evidence based on a meta-analysis of 77 studies that team-based care by a pharmacist, nurse, dietician, or community health worker that includes lifestyle behavioral counseling and medication management improves BP and lipid control.[6] Team care typically includes use of evidence-based guidelines, patient engagement in self-care, facilitated iterative communication and care coordination between the patient and team members, ongoing monitoring, and follow-up.

An important question is whether new technology tools can effectively support and deliver team-based care outside the clinic. Our previous trial demonstrated that patients who received home BP monitoring and pharmacist-led team care delivered over the Web using an existing patient-shared electronic health record (EHR) and secure messaging had reduced BP and improved hypertension control[7] compared to usual care (UC) or home BP monitoring alone. In this study, pharmacists used a protocol to increase hypertensive medications based on home BP measurements reported by study participants via secure messaging. Patients also chose at least one lifestyle behavior change to work on, such as weight loss or increasing physical activity. Web-based pharmacist team care patients were more likely to be on more antihypertensive medications than those receiving UC or home BP monitoring alone, but differences were not significant between groups for weight loss or change in physical activity. However, for all patients, those who lost weight were more likely to have controlled BP than those who maintained or gained weight. Thus, we hypothesized that collaborative, dietitian-led team care that included home BP, weight, and fruit and vegetable intake monitoring with feedback, counseling, and care coordination (between the patient and their physician for medication changes) delivered using EHR-linked secure messaging would be feasible to implement. We further hypothesized that this intervention would lead to weight loss, reduced BP, and reduced CVD risk scores. We describe herein a feasibility trial to test these hypotheses.

Methods

The e-Care for Heart Wellness Study was a two-arm randomized controlled trial (RC1HL100590-01) designed to test the feasibility of using Web-based dietitian team care to improve BP control and reduce CVD risk by modifying diet, activity level, and medication use. All study activities were conducted at the Group Health Cooperative, a nonprofit mixed-model health care system in Washington State. Study participants were recruited between 2010 and 2011 from four Group Health Medical Centers in Western Washington. All study processes were approved by the Group Health Institutional Review Board and an independent Data Safety Monitoring Board monitored the study findings.

The study design, similar to our previous trial,[7] was based on the Chronic Care Model (CCM)[8] and its six domains: 1) evidence-based decision support (in this trial, as guidelines for improving hypertension and lipid control); 2) patient self-management support (as help with behavioral improvements); 3) delivery design (patient-centered medical home and team care); 4) information systems such as Group Health's patient-shared EHR with patient-provider messaging; 5) community support through community resources for promoting a healthy lifestyle; and 6) health care systems (infrastructure and compensation models that supported Web-based team care). According to the CCM, optimization and integration of the six domains lead to positive interactions between activated patients and improved practice teams. The CCM has been implemented in multiple health care settings and has led to improved health outcomes and patient experiences.[9,10]

Study Participants

Group Health's EHR was used to identify registered users of Group Health's secure website who were aged 35–69 years with at least 2 years of enrollment and one primary care visit in the previous 2 years, BP>140 mmHg systolic or >90 mmHg diastolic at the most recent primary care visit, BMI>26, and Framingham CVD risk score between 10% and 25% (Figure 1). Patients with a history of CVD, diabetes, severe illnesses (e.g., renal failure or dementia), or illnesses that would make participation difficult (e.g., pregnancy, schizophrenia, or alcohol dependence) were excluded. Patients meeting the criteria were mailed an invitation and called to confirm eligibility, willingness, and availability to participate in a one-time baseline study screening and intervention visit. Patients with BP>140 mmHg systolic or >90 mmHg diastolic (using the validated Omron 907XL BP monitor[11] averaging the last three of four measurements) at the screening visit were eligible to participate, and 101 patients consented and enrolled.

Randomization

Participants were randomized to UC or Web-dietitian (WD) care using a stratified block randomization design. Participants were randomized using blocks of two or four and stratified by their assigned primary care clinic and Framingham CVD risk score[12] (10%–15%, >15%–20%, and >20%–25%).

Interventions

UC participants were told during the baseline visit that their BP was high and were encouraged to follow up with their physician for appropriate care. They received a copy of their laboratory results including their Framingham 10-year CVD risk via the patient website and by mail. They received no other active interventions.

WD participants received the same information as UC patients. They were also provided with a scale, pedometer, and home BP monitor (Omron 711-DLX)[13] and trained to use these devices. They were scheduled to see a Group Health dietitian at their regular clinic and asked to complete a questionnaire routinely used by Group Health dietitians about physical activity, dietary habits, prior attempts to lose weight, and tobacco and alcohol use. Participants also completed a standard 3-day food diary. Consistent with usual dietician care, participants were encouraged to bring to the dietician meeting a family or household member with whom they routinely ate or who was responsible for shopping and preparing meals.

During the in-person visit, the dietitian reviewed the participants' questionnaire answers, food diary, and baseline study measurements including BP, BMI, lipids, and 10-year CVD risk. Participants were given a handout with their calculated "heart age,"[12] an estimate based on CVD risk factors reported relative to chronological age. For example, a patient might have a chronological age of 50 years, but a heart age of 65 years, based on their BP, smoking, and serum lipids (Online Appendix 1). Participants were informed that the study goals were to help them achieve the following targets to improve BP control and decrease CVD risk: 1) BP<140 mmHg systolic and <90 mmHg diastolic in the clinic (<135/85 at home); 2) low-density lipoprotein (LDL)<100 mg/mL; and 3) their choice of either losing weight or at least not gaining weight. To help them achieve these goals, participants were educated about the DASH Diet and encouraged to adopt this dietary plan, which includes eating–eight ten servings of fruits or vegetables a day, low-fat dairy products, reducing saturated and total fat,[14,15] and limiting salt intake. The DASH diet has been shown to significantly reduce BP and CVD risk even when weight is maintained,[16] with greater reductions in BP when combined with a low-salt diet[17] or weight loss and exercise.[18] For those choosing weight loss, the target was ≥4 kg (roughly 10 pounds), based on the Trials of

Hypertension Prevention (TOHP II) in which loss of 4.4 kg led to long-term BP control.[19] Patients wishing to lose weight were encouraged to substitute fruits and vegetables for more calorically dense foods and given assistance such as advice about purchasing and preparing food. Patients who wanted to monitor caloric intake were assisted, but this was not required.

Next, the dietitian and participant collaborated to create a personalized five-component action plan consisting of: 1) a self-monitoring plan (which included measuring BP, fruit and vegetable intake, and weight for 3 days each week and optional tracking of steps with the pedometer they received), 2) current BP and lipid-lowering medications, 3) ways to achieve short-term goals (e.g., bringing fruit to work each day or adding more steps) and long-term targets (e.g., controlling BP and lipids or decreasing weight by 4 kg or more for those who chose weight loss); 4) assessment of current status (e.g., BP control) with recommendations, and 5) a follow-up plan (e.g., a recommendation to make a physician appointment if BP was still not controlled).

After the visit, dieticians maintained communication with participants using EHR-linked secure messaging. Participants were asked to share their self-monitoring data with the dietician at least once a week for 2 months, followed by every 2 weeks for 2 months, and then every month for 2 months, for a total of 6 months. Dieticians also used secure messaging to respond to questions, remind participants to share their self-monitoring data, and provide resources (e.g., recipes and websites) and to encourage participants to reach their goals. Participants' primary care physicians received a copy of the initial assessment and laboratory results, and could view intervention secure messages in the EHR. If participants' BP or lipids were uncontrolled, both participants and their physicians (via EHR staff messages) were notified so the patient or physician could initiate steps to start or intensify antihypertensive or lipid-lowering medications. Study dietitians worked for Group Health prior to and during the study and were experienced with caring for patients with diabetes, obesity (particularly morbid obesity pre- and post-bypass surgery), and chronic diseases. Dietitians received three half-day study training sessions, which included review of guidelines for hypertension care and primary prevention of CVD, including stepped medication guidelines for elevated BP and lipid lowering, and training on the research protocol. They were also trained in and given an opportunity to practice motivational interviewing and cognitive behavioral skills training techniques, which they used in counseling WD participants. Dieticians met with the study team by phone every 2 weeks to review and debrief cases, including receiving medical advice from the study physician (B.G.) and guidance on behavioral counseling from the study psychologists (S.C. and J.M.).

Prior to patient enrollment, clinic physicians and staff received information and handouts about the e-Care study at a staff meeting. Study overview handouts were also sent to the medical director to distribute by e-mail. Physicians and staff were told they might receive messages from dietitians or patients, particularly regarding medication changes, if patients did not reach BP or lipid targets through lifestyle interventions alone.

Outcome Measures

Primary outcomes were measured at the baseline research visit prior to randomization and 6 months after randomization and included changes in systolic and diastolic BP, CVD risk, and weight and the proportion of patients with BP control (defined as BP<140 mmHg systolic and <90 mmHg diastolic) and weight loss ≥4 kg. BP and weight were measured in person using the same procedures as those at baseline. CVD risk was calculated at baseline using Framingham 10-year global CVD risk score equations.[12] At the follow-up visit, Framingham 10-year global risk scores were recalculated using baseline age and 6-month follow-up results for BP, serum lipids, and smoking status. Baseline rather than current age

was used to avoid bias associated with patients aging into a higher risk category over the study period.

Secondary outcomes were change from baseline in hemoglobin A1C, fasting blood glucose, total cholesterol, high-density lipoprotein (HDL), and LDL levels. Hypertensive medication use (yes/no) and intensification were measured using pharmacy data use methods described by Karter et al.,[20] defined as any one of the following: increase in the number of drug classes, increase in the daily dosage of at least one ongoing drug class, or switch to a different drug class. Hypertensive drugs were in 12 medication classes (beta blockers, angiotensin-converting enzyme [ACE] inhibitors/angiotensin receptor blockers, peripheral alpha-1 blockers, loop diuretics, potassium-sparing diuretics, thiazide diuretics, central alpha 2 receptor agonists, direct vasodilators, dihydropyridine calcium channel blockers, nondihydropyridine calcium channel blockers, selective aldosterone blockers, and renin inhibitors). Combination pills such as lisinopril/hydrochlorothiazide were included in both classes. Survey self-reported data collected at the baseline and 6-month research visits included fruit and vegetable intake, [21,22] physical activity,[23,24] and self-reported medication adherence using the eight-item Morisky tool, which has been validated as reliable (α=0.83) and correlated with BP control.[25] The Patient Assessment of Chronic Illness Care (PACIC) questionnaire[26] was used to assess to what degree patients self-reported receiving care aligned with patient-directed components of the CCM (patient activation, delivery design, goal setting/tailoring, problem solving, follow-up, and coordination of care). Each domain has good internal consistency for brief scales and moderate test/re-test reliability (r=0.58 over 3 months).[26] Satisfaction with BP or cholesterol care questions were based on the Consumer Assessment of Healthcare Providers and Systems (CAHPS)[27] survey items (using a Likert scale from 0–10 for worst versus best possible care) and health-related quality of life was measured using the Obesity and Weight Loss Quality of Life (OWLQOL)[28] questionnaire.

Statistical Analysis

The planned sample size of 100 randomized subjects provided 80% power to detect an effect size of 0.6 SD for the continuous outcomes, assuming 90% follow-up at the 6-month visit. This effect size corresponded to a detectable difference between groups of 9.3 mmHg for systolic BP (assuming SD=15.5), 5.1 mmHg for diastolic BP (assuming SD=5.1), and 2.7 kg for weight change (assuming SD=4.5). Analyses used STATA statistical software, version 12.0 (StataCorp, College Station TX).

Linear regression models were used to estimate differences between groups in mean change from baseline for the continuous primary outcomes of BP, weight, and CVD risk score adjusted for sex and baseline value. Generalized linear regression models with a log link were used to estimate intervention effects on binary outcomes, BP control (adjusting for sex, baseline systolic BP, and BMI) and losing 4 kg (adjusted for sex and baseline weight). Analysis of secondary outcomes followed a similar strategy, except regression models were unadjusted. The analysis used a complete-case approach, excluding participants who did not return for a follow-up visit.

Results

Study Participants

Invitation letters were sent to 965 potentially eligible patients (Figure 1). Of these, 11.2% (108/965) could not be contacted, 35.8% (345/965) refused participation, 13.1% (126/965) were ineligible (left the health plan, had no Web access, or had illness), resulting in 40.0% (386/965) who were invited to an in-person screening visit. At the visit, 53.4% (206/386)

had controlled BP and were ineligible and 26.2% (101/386) remained eligible and also provided informed consent. Baseline characteristics of the WD and UC participants were similar except for sex, with significantly more women randomized to the WD group (Table 1). Of 101 enrolled patients, 90 completed the 6-month follow-up visit.

Primary Outcomes

At the 6-month follow-up visit, WD participants had lost significantly more weight than UC (adjusted net difference= −3.2 kg [95% CI= −5.0, −1.5], $p<0.001$) and were three times more likely to have lost at least 4 kg (adjusted relative risk [RR_{adj}]=2.96 [95% CI=1.16, 7.53]). Both the UC and WD groups had reductions in systolic BP from baseline, with an adjusted mean decrease in systolic BP of −13.9 mmHg in the WD group compared to −11.4 in the UC group ($p=0.40$), with 54% of the WD group having controlled BP compared to 40% in the UC group ($p=0.16$) (Table 2). CVD risk also decreased from baseline, with an adjusted mean change in risk score of −4.1 in the WD group compared to −2.8 in the UC group ($p=0.10$).

Secondary Outcomes

Increases in daily fruit and vegetable intake were statistically significant in the WD group compared to the UC group (adjusted net difference=2.3 servings/day, $p<0.01$). Physical activity levels were not statistically significant different between groups, with only 20.5% of the UC and 27.9% of the WD groups reporting moderate activity at least 4 days a week at 6 months. Groups were also similar in changes in LDL, HDL, hemoglobin A1C, and fasting blood sugar (Table 3). Initiation and intensification of hypertensive medications occurred more frequently in the WD group; however, the differences were not statistically significant. BP medication adherence did not differ by group. Quality-of-life measures for obesity and weight loss showed greater improvement in WD participants than in UC participants, but the difference was not statistically significant. At 6 months, WD participants were statistically more likely to be satisfied with their BP care compared to UC participants, but there was no difference between groups in satisfaction with overall health care (data not shown). WD participants were statistically significantly more likely to report that they received patient-centered care consistent with the CCM compared to UC participants for all five domains and the total score.

Process Measures and Qualitative Assessments

All but one patient assigned to WD attended the initial in-person dietitian visit. Ongoing team care communications occurred almost entirely by secure e-mail, with over half of WD participants having 13 or more e-mail threads (back-and-forth exchanges originating from one or more e-mails). Only one WD participant had no e-mail exchanges and the rest had at least five. Phone communications with dieticians were infrequent, but occurred if requested or required to address participants' concerns.

WD participants were asked to rate the parts of the intervention they thought were most useful in managing their health since enrolling in the study. More than 60% reported that measuring BP at home, sharing BP measures with providers, e-mailing or talking with a dietitian, and getting a "list of medications and things I should do" were extremely helpful. Less often ranked as extremely helpful were medication-related activities: starting a new BP medication (56%), starting a new cholesterol medication (25%), or changing the dose "of my old medications" (11%). In exit interviews with participants, some shared that starting antihypertensive medications felt like an admission of failure to make important lifestyle changes to improve health.

Field notes and exit interviews with dietitians revealed that dietitians had difficulty engaging some physicians in medication management, reporting that physicians either failed to respond or stated in one case, “it is up to the patient to make an appointment.” WD participants were reluctant to make physician appointments to follow up on medication issues, with many reporting that they wanted to focus on behavioral changes instead. On occasion, dieticians who strongly recommended participants consider medication changes and follow up with their providers found that participants stopped communicating with the dietitian.

Discussion

The e-Care for Heart Wellness trial demonstrated a promising BP/CVD-risk reduction intervention. The study was feasible to conduct using Group Health-employed dietitians and existing EHR systems for secure e-mail communications and had high rates of patient participation and satisfaction with the intervention. The WD group lost significantly more weight than UC participants. They also increased their fruit and vegetable intake and were more satisfied with their BP and cholesterol care. While BP control improvements and CVD risk reductions were greater in WD than UC participants, differences were not significant, but this feasibility trial was not powered to find these changes. However, the magnitude of the differences in BP control improvement (14.4%) and reduction in CVD risk score (−1.3) between groups were similar to those found to be significant in meta-analyses and larger team care trials.[6,29-31] Therefore, we believe that the e-Care for Heart Wellness intervention has merit and warrants further evaluation in a larger randomized controlled trial.

Despite potential evidence of the intervention’s effectiveness, several issues warrant further discussion. In our previous study,[7] pharmacists had prescriptive authority to change hypertensive medications, resulting in significant increases in medication intensification. The WD intervention was also designed to be team-based, with collaborative care between patients, dietitians, and patients. Dietitians had protocols for addressing BP and LDL persistently elevated above target and notifying physicians and patients that medication needed to be started or intensified. Initiation and intensification of hypertensive medications occurred more frequently in the WD group; however, the differences were not statistically significant. Qualitative assessments suggested that some patients who prefer lifestyle treatments might have been resistant to medication changes even though they were told that they were at moderate-to-high risk for CVD or had unrealistic expectations about the ability of lifestyle changes to control BP and LDL. Additional exploration is needed to better understand and positively influence patient knowledge, attitudes, and beliefs about the role of medications and lifestyle changes in controlling BP and lipids.[32,33] Medication intensification almost always led to reductions in systolic BP (with marked reductions for some) for both UC and WD patients, while weight loss generally led to more modest reductions in BP (Online Appendix 2), emphasizing the importance of medications for patients not achieving BP control by lifestyle changes alone.[34]

Challenges were also encountered in engaging some physicians, who either did not respond to dieticians’ recommendations to follow up with patients about BP or placed the responsibility on the patient. Physicians might not have understood their role on the team despite outreach at clinical staff meetings, including introducing the study, describing provider roles, and distributing information sheets at meetings and by e-mail. In the Community Preventive Services Task Force systematic review, most team care providers were nurses or pharmacists.[6] Some teams included a dietitian,[35,36] but none used dietitians as team leaders. Dieticians could be at a disadvantage, for example, compared to pharmacists who have greater ability to change medications, resulting in greater BP improvements. It is also possible that dietitians were not used to directing physicians, a role

that might come more naturally to a pharmacist or nurse. Building on these observations, a future model might include teams with both pharmacists and dietitians, giving patients more support for both medication and lifestyle changes.

Our study, while designed primarily to address uncontrolled BP and CVD risk, adds to the increasing number of studies showing that clinical settings can be used to identify and recruit overweight and obese patients for remotely delivered interventions that lead to weight loss[5,37,38] and increased fruit and vegetable intake. These outcomes are important in their own right and are particularly encouraging in light of the rapidly expanding field of mobile health technology that promises to further push the boundaries of effective delivery of clinical care outside traditional clinical settings. Further assessment of the long-term persistence of these dietary and weight loss changes and their cost effectiveness are needed.

Study limitations include small sample size and lack of sufficient power to demonstrate whether reductions in BP and CVD risk were significant and to understand whether dietitians had at least some impact on medication intensification. Additional limitations include short follow-up (6 months), more women randomized to WD than men, and a racially homogeneous sample that might not be representative of all patient populations. Self-reported measures (e.g., fruit and vegetable intake) might have been subject to social desirability bias. The study design also did not allow us to test the specific components of the intervention that were most effective. This study also has several notable strengths. We used EHR records alone to identify potential participants and found that most were willing to be screened and participate if eligible. Except for the initial visit, dietitian encounters were almost all via secure messaging using existing EHR technologies. This communication style allowed asynchronous interactions that were more convenient for dieticians and participants. While BP changes were not significant, the magnitude of BP control and reduction in CVD risk was similar to those of other team care studies. Future studies should explore whether dietitians could be part of team care that specifically includes medication management.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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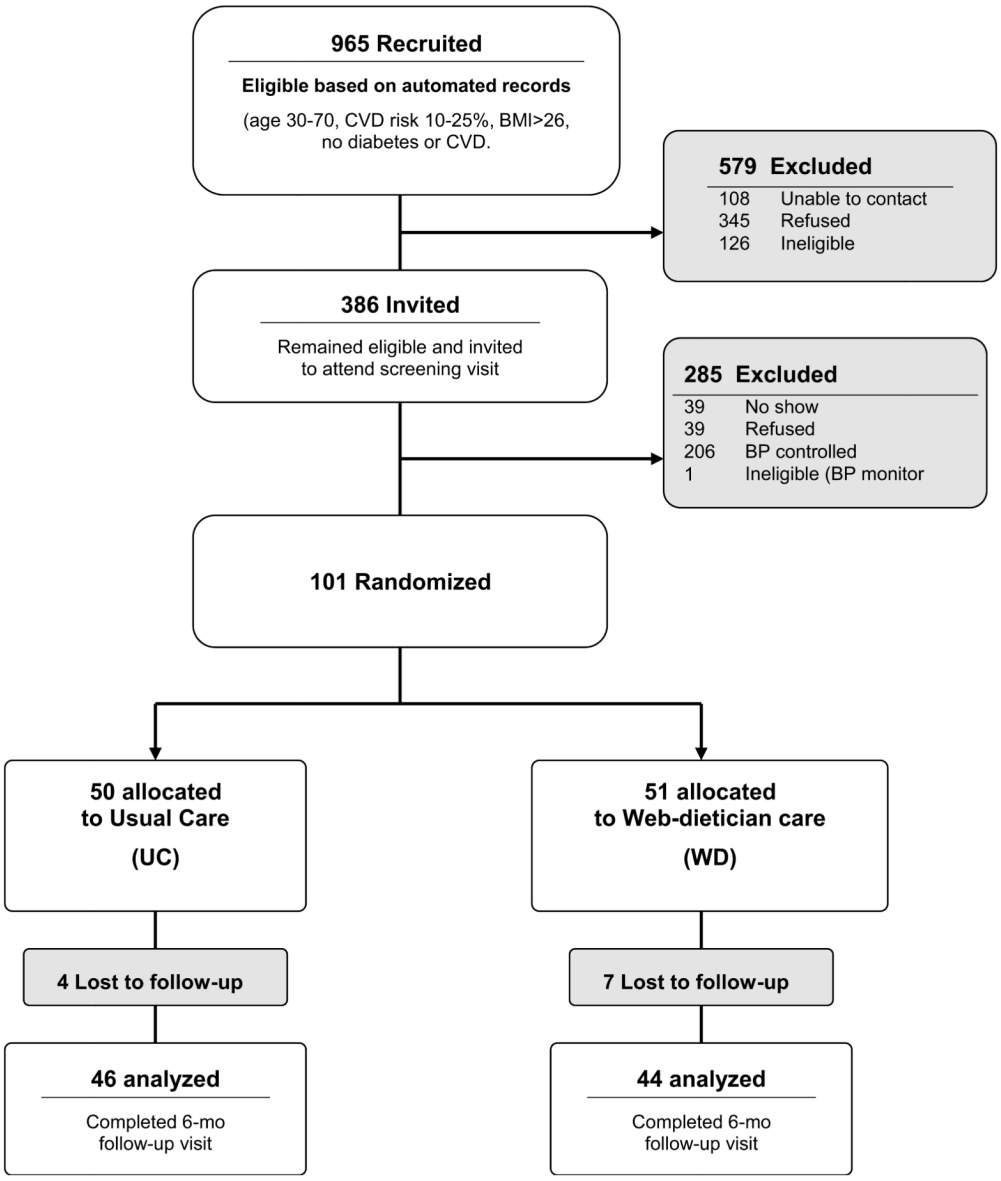

Figure 1.
e-Care for heart wellness Consort diagram
CVD, cardiovascular disease; BP, blood pressure

Table 1

Baseline characteristics of e-Care participants

Characteristic[a]	Total	Control	Web-dietitian	*p*-value
	***N*=101**	***n*=50**	***n*=51**	
Age, M (SD)	56.9 (7.0)	57.8 (6.7)	55.9 (7.2)	0.18
Women, *n* (%)	42 (42)	15 (30)	27 (53)	0.02
Race, *n* (%)				
White	86 (85)	42 (84)	44 (86)	0.87
Black	5 (5)	2 (4)	3 (6)	
Asian	3 (3)	2 (4)	1 (2)	
Other	7 (7)	4 (8)	3 (6)	
Education, *n* (%)				
≤12 years or GED	6 (6)	2 (4)	4 (8)	0.81
Some post-high school	32 (32)	15 (31)	17 (34)	
4-year college degree	35 (35)	18 (37)	17 (34)	
Graduate school	26 (26)	14 (29)	12 (24)	
Employed full-time, *n* (%)	75 (74)	38 (76)	37 (73)	0.69
Married, living with partner, *n* (%)	74 (75)	38 (78)	36 (72)	0.53
Current smoker, *n* (%)	7 (7)	2 (4)	5 (10)	0.25
On lipid-lowering meds, *n* (%)	22 (22)	13 (26)	9 (18)	0.31
Hypertension medication classes, *n* (%)				
0	58 (57)	29 (58)	29 (57)	.62
1	22 (22)	9 (18)	13 (25)	
2	17 (17)	9 (18)	8 (16)	
3 or more	4 (4)	3 (6)	1 (2)	
Hypertension medication adherence,[b] M (SD)	2.3 (1.7)	2.3 (1.8)	2.4 (1.7)	0.91
Systolic BP, M (SD)	150.4 (11.7)	150.6 (11.9)	150.1 (11.6)	0.82
Diastolic BP, M (SD)	91.6 (9.2)	90.7 (9.5)	92.6 (8.8)	0.30
CVD risk, M (SD)	16.3 (6.6)	17.0 (6.6)	15.6 (6.7)	0.28
HBA1c, M (SD)	5.7 (0.6)	5.6 (0.4)	5.7 (0.8)	0.32
Fasting blood sugar, M (SD)	102.0 (21.9)	101.1 (14.6)	102.8 (27.5)	0.70
Total cholesterol, M (SD)	211.8 (37.2)	205.3 (39.9)	218.1 (33.6)	0.08

Characteristic[a]	Total	Control	Web-dietitian	*p*-value
	***N*=101**	***n*=50**	***n*=51**	
HDL cholesterol, M (SD)	52.7 (15.5)	53.7 (18.5)	51.8 (11.9)	0.54
LDL cholesterol, M (SD)	128.7 (33.6)	122.2 (36.8)	134.9 (29.2)	0.06
BMI, M (SD)	33.9 (5.7)	33.3 (5.6)	34.5 (5.8)	0.30
Weight (kg), M (SD)	100.0 (18.0)	99.4 (17.9)	100.7 (18.2)	0.72
Waist circumference (inches), M (SD)	43.6 (4.8)	43.3 (5.1)	43.8 (4.6)	0.60
Fruits and vegetables, number of servings, M (SD)	3.7 (2.3)	4.0 (2.3)	3.4 (2.3)	0.17

GED, general education development; BP, blood pressure; CVD, cardiovascular disease; HBA1c, hemoglobin A1c; HDL, high-density lipoprotein; LDL, low-density lipoprotein

[a]Missing values (*n*): education (2); marital status (2); fasting blood sugar (1); LDL cholesterol (1); fruits and vegetables (1).

[b]Morisky self-reported hypertension medication adherence (range=0–8, with higher scores indicating worse adherence).

Table 2
Primary outcomes for e-Care participants who completed the follow-up visit, *n*=90

	Control	Web-dietitian	Adjusted difference between groups	*P*-value[e]
Patients completing follow-up visit	46	44		
Systolic BP (mmHg)				
Unadjusted M (SD)	139.1 (14.1)	136.4 (13.9)		
Adjusted[a] M change (95% CI)	−11.4 (−15.4, −7.3)	−13.9 (−18.1, −9.8)	−2.6 (−8.6, 3.4)	0.40
Diastolic BP (mmHg)				
Unadjusted M (SD)	84.6 (9.5)	84.0 (10.2)		
Adjusted[a] M change (95% CI)	−6.6 (−9.2, −3.9)	−8.5 (−11.3, −5.8)	−2.0 (−6.0, 2.0)	0.32
Weight (kg)				
Unadjusted M (SD)	99.7 (17.4)	97.0 (17.6)		
Adjusted[a] M change (95% CI)	−0.5 (−1.6, 0.7)	−3.7 (−4.9, −2.5)	−3.2 (−5.0, −1.5)	<0.01
CVD risk score[b]				
Unadjusted M (SD)	13.8 (4.8)	11.4 (4.4)		
Adjusted[a] M change (95% CI)	−2.8 (−3.9, −1.7)	−4.1 (−5.2, −3.0)	−1.3 (−2.9, 0.3)	0.10
BP control				
Number controlled (%)	18 (39.1)	24 (54.5)		
Adjusted[c] relative risk (95% CI)	1.00 (ref)	1.39 (0.88, 2.21)	–	0.16
Weight loss ≥4 kg				
Number lost ≥4 kg (%)	5 (10.9)	14 (31.8)		
Adjusted[d] relative risk (95% CI)	1.00 (ref)	2.96 (1.16, 7.53)	–	0.02

BP, blood pressure; CVD, cardiovascular disease

[a] Adjusted for gender and the baseline measure of the outcome.

[b] Missing values: CVD risk (4).

[c] Adjusted for gender, baseline systolic BP, and BMI.

[d] Adjusted for gender and baseline weight.

[e] *p*-values from adjusted analyses.

Table 3

Secondary outcomes for e-Care participants who completed the follow-up visit, *n*=90

	Control	Web-dietitian		
	M (95% CI)	**M (95% CI)**	**M difference between groups (95% CI)**	***P*-value**
Patients completing follow-up visit	46	44		
Change from baseline				
HBA1c	0.1 (−0.0, 0.1)	−0.0 (−0.1, 0.1)	−0.1 (−0.2, 0.0)	0.11
Fasting blood sugar	−1.0 (−3.9, 1.8)	−0.7 (−3.3, 1.9)	0.3 (−3.5, 4.2)	0.86
Total cholesterol	−1.8 (−11.4, 7.9)	−5.7 (−13.0, 1.7)	−3.9 (−16.1, 8.2)	0.52
LDL cholesterol	−5.2 (−11.6, 1.2)	−7.0 (−14.0, 0.0)	−1.8 (−11.3, 7.7)	0.71
HDL cholesterol	−0.3 (−2.8, 2.1)	1.5 (−0.4, 3.5)	1.9 (−1.2, 5.0)	0.24
Fruits and vegetables, number of servings	0.0 (−0.5, 0.6)	2.3 (1.4, 3.2)	2.3 (1.2, 3.3)	<0.01
Hypertension medication classes, number of classes	0.1 (0.0, 0.4)	0.4 (0.1, 0.7)	0.2 (−0.1, 0.5)	0.16
Hypertension medication adherence *b,c*	−0.2 (−0.8, 0.3)	−0.1 (−0.7, 0.5)	0.1 (−0.7, 0.9)	0.79
Satisfaction with hypertension care (0–10 scale)	−0.5 (−1.1, 0.2)	1.3 (0.4, 2.1)	1.7 (0.7, 2.7)	<0.01
Obesity and weight loss quality of life *a*	2.5 (−0.4, 5.3)	5.5 (2.7, 8.3)	3.0 (−1.0, 7.1)	0.14
Patient assessment of chronic illness care				
Overall score	−0.1 (−0.5, 0.2)	2.0 (1.6, 2.3)	2.1 (1.6, 2.6)	<0.01
Patient activation/self-efficacy	−0.4 (−0.8, 0.0)	2.1 (1.7, 2.6)	2.5 (1.9, 3.1)	<0.01
Delivery system/practice design	−0.3 (−0.7, 0.2)	2.0 (1.5, 2.5)	2.3 (1.6, 2.9)	<0.01
Goal setting/tailoring	−0.1 (−0.6, 0.3)	2.1 (1.7, 2.5)	2.3 (1.7, 2.8)	<0.01
Problem solving/contextual	−0.3 (−0.6, 0.1)	2.0 (1.6, 2.4)	2.2 (1.7, 2.8)	<0.01
Follow-up/coordination	−0.1 (−0.4, 0.2)	1.6 (1.2, 2.0)	1.7 (1.2, 2.2)	<0.01
Proportion at follow-up	% (95% CI)	% (95% CI)	RR (95% CI)	
Taking any hypertension medications	52.2 (37.7, 66.6)	63.6 (49.4, 77.9)	1.22 (0.85, 1.74)	0.27
Hypertension medication intensification *b*	41.7 (21.9, 61.4)	55.2 (37.1, 73.3)	1.32 (0.74, 2.36)	0.34
Physical activity, often work up a	20.5 (8.5, 32.4)	27.9 (14.5, 41.3)	1.36 (0.64, 2.90)	0.42

	Control	Web-dietitian		
	M (95% CI)	**M (95% CI)**	**M difference between groups (95% CI)**	***P*-value**
sweat				

HBAlc, hemoglobin A1c; HDL, high-density lipoprotein; LDL, low-density lipoprotein; RR, relative risk

[a] Range=1–10, with higher numbers representing better self-reported quality.

[b] Intensification and adherence not defined for patients not taking hypertension medications.

[c] Morisky self-reported hypertension medication adherence (range=0–8, with higher scores indicating worse adherence).