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RESEARCH ARTICLE

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Integrating an internet-mediated walking program into family medicine clinical practice: a pilot feasibility study

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Abstract

Background: Regular participation in physical activity can prevent many chronic health conditions. Computerized self-management programs are effective clinical tools to support patient participation in physical activity. This pilot study sought to develop and evaluate an online interface for primary care providers to refer patients to an Internet-mediated walking program called Stepping Up to Health (SUH) and to monitor participant progress in the program.

Methods: In Phase I of the study, we recruited six pairs of physicians and medical assistants from two family practice clinics to assist with the design of a clinical interface. During Phase II, providers used the developed interface to refer patients to a six-week pilot intervention. Provider perspectives were assessed regarding the feasibility of integrating the program into routine care. Assessment tools included quantitative and qualitative data gathered from semi-structured interviews, surveys, and online usage logs.

Results: In Phase I, 13 providers used SUH and participated in two interviews. Providers emphasized the need for alerts flagging patients who were not doing well and the ability to review participant progress. Additionally, providers asked for summary views of data across all enrolled clinic patients as well as advertising materials for intervention recruitment. In response to this input, an interface was developed containing three pages: 1) a recruitment page, 2) a summary page, and 3) a detailed patient page. In Phase II, providers used the interface to refer 139 patients to SUH and 37 (27%) enrolled in the intervention. Providers rarely used the interface to monitor enrolled patients. Barriers to regular use of the intervention included lack of integration with the medical record system, competing priorities, patient disinterest, and physician unease with exercise referrals. Intention-to-treat analyses showed that patients increased walking by an average of 1493 steps/day from pre- to post-intervention ($t = (36) = 4.13, p < 0.01$).

Conclusions: Providers successfully referred patients using the SUH provider interface, but were less willing to monitor patient compliance in the program. Patients who completed the program significantly increased their step counts. Future research is needed to test the effectiveness of integrating SUH with clinical information systems over a longer evaluation period.

Keywords: Pedometer, family medicine, Internet-mediated intervention, physical activity, walking, primary care, patient-centered medical home

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Background

Physical activity is recommended as first-line medical therapy for preventing and managing many chronic diseases [1-4]. Moderate-intensity physical activity such as walking can reduce the risk of developing chronic diseases, particularly among individuals at high risk for type 2 diabetes and cardiovascular disease [5-10]. However, there are few effective interventions for promoting physical activity in the primary care setting [11,12].

Medical guidelines emphasize the active role primary care physicians (PCPs) should play in helping patients initiate and sustain physical activity programs. Provider recommendations can help motivate patients to initiate an exercise program. PCPs can also be instrumental helping patients safely re-engage in activity after an illness or medical issue [9,13,14]. In practice, a provider's ability to promote physical activity has been limited by time constraints, lack of training in exercise prescription, concerns over monitoring patient safety, and lack of access to cost-effective resources that help patients remain active [11,12,15-17]. Internet-based, computer-tailored intervention programs may make it easier for providers to support patients with personalized self-management information and encouragement and thus facilitate sustained adherence to physical activity [18-20].

We previously developed and tested Stepping Up to Health (SUH), an Internet-mediated walking program for people with chronic illness. SUH is a multi-component, theory-based physical activity intervention that uses uploading pedometers to objectively monitor and track daily walking and to set personalized goals [21,22]. SUH was specifically designed to help sedentary patients diagnosed with type 2 diabetes, coronary artery disease, or obesity become physically active and reduce their cardiovascular disease risk. The program focuses on home-based unsupervised walking, a low-risk mode of physical activity that can be performed without direct clinical supervision even in high-risk patients [8]. SUH increased walking among sedentary individuals with diabetes by an average of approximately 1 mile or 20 minutes of walking per day over a six-week period [21]. These high-risk individuals are precisely the patient population that is most likely to derive the greatest benefit from moderate increases in activity through reduced cardiovascular mortality and morbidity [23]. However, like many promising Internet-based physical activity programs, SUH has not been translated into a clinical tool that could enable providers to effectively promote physical activity as part of routine care.

Clinical tools for primary care practice that improve efficient resourcing and patient outcomes are fundamental to the patient-centered medical home (PCMH) model of care. The PCMH model aims to improve

patient outcomes through the use of technological innovations, shared responsibilities among collaborative provider teams (e.g., physicians, nurses, physician assistants, and medical assistants), and personally-tailored preventive health programs delivered at a population level [24,25]. While Internet-based patient self-management programs offer the benefits of reaching many patients at low cost, they must first be integrated into clinical practice through iterative testing and refinement with provider input [26,27]. The potential of SUH to help PCPs achieve PCMH goals is limited if PCPs do not find SUH easy to use in combination with other key clinical tools such as the electronic medical record (EMR).

This pilot study was designed to accomplish two objectives: 1) to develop a clinical interface with provider input that allows PCPs to efficiently refer patients to SUH and to serially monitor their progress and safety; and 2) to evaluate the feasibility of incorporating the SUH intervention into clinical practice using qualitative interviews, process and satisfaction measures and objective measures of patient physical activity via daily pedometer step counts. The design and implementation of the clinical interface for SUH was driven by the principles of the PCMH model to improve patient-centered care and outcomes through the use of an *e*-health technology accessible by practice care teams. This pilot study was funded through the University of Michigan's Institute for Clinical & Health Research (UL1RR024986), which is funded by a National Institutes of Health Clinical and Translational Sciences Award program.

Methods

We used a two-phased, mixed-method design to: 1) develop an online clinical interface allowing providers to refer patients to the SUH intervention and to monitor their program compliance; and 2) evaluate the feasibility of implementing SUH in clinical practice. This study was approved by the University of Michigan Institutional Review Board (HUM00016019), and both provider and patient participants completed an informed consent process.

Phase I

Sample

We recruited six pairs of physicians ($n = 6$) and medical assistants (MAs; $n = 7$) from two family medicine clinics in a large healthcare system. These provider pairings were representative of local clinical processes of care. All providers gave written informed consent and received a \$150 honorarium, a SUH t-shirt, a water bottle, and a one-year membership to WalkingSpree.com, a commercial Internet walking program.

Clinical interface development

We employed an *iterative* design process to elicit provider input into the features of the clinical interface [28,29]. Providers were asked to use the SUH intervention for *at least* one week with an emphasis on the features for enrolling patients into the program. Subsequently, investigators DEG and LRB conducted semi-structured, 30-45 minute interviews ("Interview 1") to understand provider attitudes about SUH usability, and recommendations for the interface. During each interview, the interviewer guided the provider participant through existing or demonstration versions of potential web pages to elicit provider needs for key features that would facilitate use. Questions and probes in the semi-structured interview were developed by our research team, and interviews were recorded and transcribed for later analysis of key themes.

Based on provider feedback, the study team worked with computer programmers and an expert in medical informatics to develop automated features necessary for providers to refer patients to the existing SUH participant program and to track their progress. Paper mock-ups of the interface were presented to providers for review, and additional feedback was gathered for interface refinement (in "Interview 2") followed by further interface development. A key component of qualitative analysis is "member checking" in which research team interpretation of interview content is reviewed with participants to clarify and ensure accuracy. Feedback from providers served as a member check for the accuracy of the interpretation of Interview 1 results and as a check that the interface would realistically fit in regular practice work flows (i.e., external validity) [30]. Furthermore, two family physicians on the research team (investigators CRR, CWK) also served as validity checks at each step of the design process to ensure the external validity of features incorporated into the interface.

Phase II

Sample

Each physician-MA pair was asked to recruit 6-8 sedentary adult patients with coronary artery disease, type 2 diabetes, and/or BMI > 25 to participate in the SUH intervention. Patients received a \$25 incentive and a one-year WalkingSpree.com membership for completion.

Recruitment

As described in Figure 1, providers referred potential patients to the SUH intervention using the newly developed clinical interface. We supplied providers with lists of eligible patients identified from a clinical patient database. Provider referral to the program was considered implicit medical clearance for program participation.

Referred patients were directed to an enrollment website that verified their eligibility.

Eligible patients completed an online consent form with a click-through consent process before participating. During the six-week SUH intervention, participants were asked to wear a pedometer, upload step-count data to the SUH server, and review a personalized website with step-count feedback, individualized goals, tailored motivational messages, and educational tips. Patient participants completed an online satisfaction survey during week six of the intervention. Finally, within 2-3 weeks of having all recruited patients complete the intervention, a semi-structured interview was conducted with each provider to assess provider attitudes and perceptions of using the interface with patients as well as beliefs about the broader feasibility of using SUH within their clinical practice ("Interview 3").

Qualitative Data Analysis

Provider interview data was independently coded by two raters (investigators LRB, DEG) to identify key themes, and a third rater (investigator CRR) helped achieve consensus in cases of disagreement [31]. Identified themes were classified into three categories: 1) comments about the SUH patient intervention; 2) comments regarding the process for recruiting and referring patients; and 3) suggestions for how to design the clinical interface for recruiting patients and tracking their progress in the program. Qualitative results from the first two provider interviews were shared with the research team to inform the clinical interface development. Qualitative results from the third provider interviews were used to evaluate the interface's usability and the feasibility of incorporating the intervention into everyday practice. A fourth member of the research team and provider at one of the research sites (investigator CWK) performed a member check to verify the validity of the conclusions' recommendations for interface development as well as the summary themes that emerged from qualitative analysis.

Quantitative Data Analysis

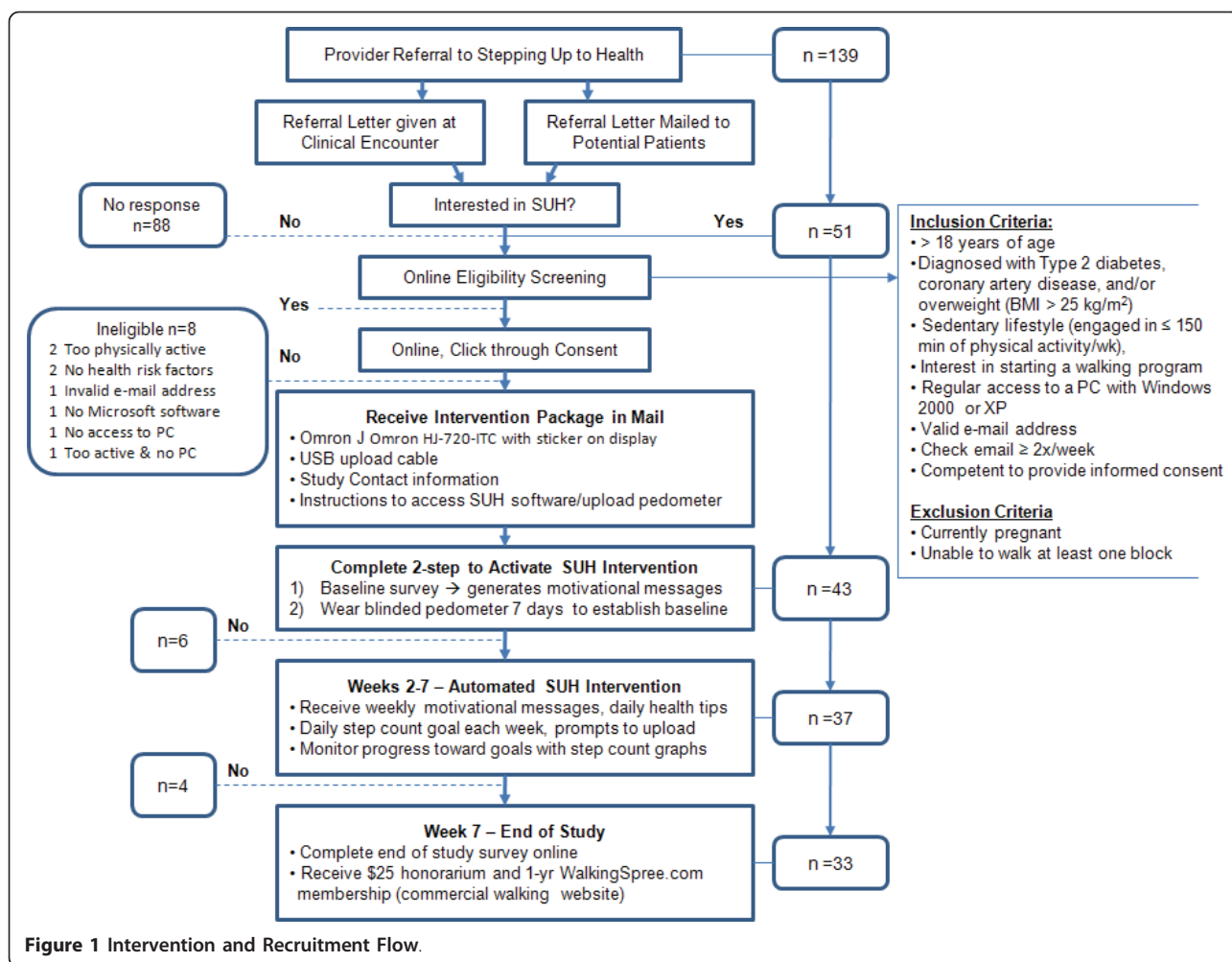
Descriptive statistics were used to summarize referral patterns, patient characteristics, and utilization patterns of the clinical interface. Paired t-tests were used to compare patient baseline and end-of-intervention step counts. Details of step-count analysis including methods of handling missing data have been described previously [21,32]. Quantitative data analysis was performed using STATA 10.1 (StataCorp, College Station, Texas).

Results

Phase I

Recommendations for clinical interface capabilities

Several themes emerged (see Table 1) regarding features that providers desired in a clinical interface. These



included notification alerts for individuals who consistently fell short of their program goals over weeks or months, for exercise-related adverse events, or for occasions where the patient consistently failed to upload his or her pedometer over a pre-specified period of time. Additional comments focused on the intervention's capacity for electronic follow-up (i.e., a reminder to view patient data or to send emails to patients). Some providers wanted to view all of the SUH patients within a specific practice and to integrate different types of data logging such as blood pressure, weight, caloric intake, and glucose. Finally, providers indicated a preference for access to printable summary reports for oversight and use during clinical encounters.

Recommendations for recruitment and referral

Providers specified they would like posters, brochures, and/or other print-based handouts to distribute to patients for recruitment and to provide more program details. Despite the proposed ability of the clinical interface to monitor program participation, many providers expressed concern that motivating individuals to start

and stay compliant with SUH would be a challenge: "The big part of it is just having something to get people motivated and doing it."

Clinical interface innovations

Based on provider input, we developed a clinical interface that included the following pages (see additional file 1 - SUH Clinical Interface Screenshots):

Patient Referral Page Upon entering a patient's name and identification number, providers could automatically generate a personalized recruitment letter containing basic information about the intervention, research study, and enrollment procedures. This letter could be distributed to the patient during a clinical encounter or mailed to the patient.

Clinic Summary Page Providers could view a list of patients enrolled in the study; which included summary information about the status of each patient regarding completion of baseline enrollment criteria and progress in the intervention phase of the program.

Detailed Patient Page Providers could view detailed patient walking data including a graph of daily step

Table 1 Qualitative data themes elicited from provider interviews about the interface

Qualitative Theme	Exemplary Quote
Phase I	
<i>The SUH Intervention</i>	<ul style="list-style-type: none"> • "I like the site." • "Very slick. It's very impressive." • "I found it pretty easy to use." • "I liked the graphs. I think the visuals were useful." • "I think the graphs are excellent the way they are. It's simple. It explains it. It nails it down to a T."
<i>Recruitment & Referring</i>	<ul style="list-style-type: none"> • "A hand out of some sort is helpful. Just like a single page, here's what it's about, here's the website." • "Some advertisements. Some posters out front. Something that might motivate the patient while they're waiting to be called back to the room."
<i>Interface Capabilities</i>	<ul style="list-style-type: none"> • "...it would be helpful to have something that my medical assistant or somebody in the office could print out on the day that the patient was coming in and say this is what their steps have been doing and so I didn't have to log in necessarily or have them upload any pedometer information at the visit just to make it as quick as possible to go through."
Phase II	
<i>Referral Process</i>	<ul style="list-style-type: none"> • "It seemed like the only time that it worked was if it was a face-to-face initiation from we [sic] offering it. The letters that we sent out...no one took notice..."
<i>Impact on Workflow</i>	<ul style="list-style-type: none"> • "It would be nice if I'd had [MA] ... kind of do it for me. But if there was any way that I could link up with the patient record I'm looking at because essentially if it pulls the data from [EMR] than this is all filled out for me basically and I just pick the yes, no - this is an acceptable patient for a walking trial and click send, and it is done."
<i>Patient Monitoring</i>	<ul style="list-style-type: none"> • "...just remember that it exists. I did not remember. I had the [study] fliers. I had like the thing put in front of my face on the bulletin board but we're so focused on the computer. I guess if I had opened the website every day then it would trigger me to remember it but I didn't remember it most of the time."
<i>Interface Usability</i>	<ul style="list-style-type: none"> • "It's a great tool. It's not necessarily a time saver. It just gives me a lot more information than I otherwise would get. Real information, not the patient's perception of their own exercise when I see them once a year or four times a year for their follow up. It's real hard data which is very helpful..."
<i>Barriers to Use</i>	<ul style="list-style-type: none"> • "So in that short 6-7 weeks span, the chance of seeing one of these patients in the office while they're doing it is pretty limited and that's really when I'm most prompted to pull up their data and look at it." • "...it would kind of be nice if the doctors included us [MAs] more in it...Kind of give us feedback about some of the adverse reaction emails that they [patients] had or... touch base so that we knew what was going on with the patients ...So that we didn't just refer them, and then they were kind of just out there..."

counts and weekly step-count goals. Additional features included a list of any illnesses and/or injuries reported by a participant, as well as active hyperlinks for providers to directly email patients or the study team.

We also developed non web-based materials including posters and flyers to aid providers with patient recruitment.

Phase II

Clinical referral process (see Table 1 for themes elicited from provider interviews)

Providers generated 139 referral letters that were mailed or distributed to patients at appointments. Overall, 37 of the referred patients (27%) began the intervention with 34 of the patients (92%) completing the program (Figure 1).

The majority of provider pairs reported that the referral page was simple and straightforward. However, some physicians indicated that it was often difficult to fit a referral into a clinical visit due to competing priorities. In addition, lack of knowledge and comfort with physical activity counseling was cited as a barrier to referral.

Impact of referrals on clinic workflow

Physician-MA pairs referred patients during office visits or by mail, with both strategies requiring additional time for coordinating and implementing the referral

process. Several pairs found success when physicians discussed physical activity with patients during clinical encounters, offering SUH as a way to increase physical activity while MAs completed the referral process.

Physicians typically viewed referrals as an additional time burden, with one physician commenting: "I'm trying to do so many things ...I never figured out how to fit it in." In contrast, MAs viewed the referral process as more feasible: "...We always have another thing added on. It's just like any other thing...So I mean an extra couple minutes...you really don't notice it after a while after you get used to doing it."

Implementation of the clinical interface for patient monitoring

The frequency of use of the clinical interface for monitoring patient progress was low. Website usage logs showed that the Clinic Summary Page was viewed a total of 100 times across all provider participants. The Detailed Patient Pages were viewed for only 15 of the 37 participants for a total of 23 page views.

Providers mentioned that because SUH was not integrated into their electronic medical record (EMR) system, accessing the program was not convenient as it required taking time during a clinical visit to find the website and remember their username and password.

Many providers noted that they lacked a visual cue to login to the interface.

Once providers logged into the interface, feedback regarding usability was positive. Providers found the Detailed Patient Page easy to use and reported “*enough basic info*” was presented to quickly check a patient’s progress. Both physicians and MAs felt that this was functional, informative, and that graphical display of patient walking progress was effective.

Several barriers to interface use were attributed to the short duration of the pilot intervention, which made it more difficult to integrate it into normal processes of care. Some providers requested email prompts to review specific patient records for situations that could necessitate provider follow-up or encouragement. These situations could include the occurrence of a medical event affecting walking, low program participation, or a scheduled clinical encounter. Moreover, some MAs observed that once they assisted with the referral phase of the program, they were largely left out of monitoring patient progress, even though they were more likely to interact with patients between routine visits. Finally, lack of time to cover physical activity discussions during brief patient visits was a ubiquitous barrier to effectively using the interface.

Patient results

The 37 patients who began the SUH intervention had a mean age of 45.2 (SD = 9.9) and were predominantly female, white, clinically obese, and well-educated (Table 2). Almost two-thirds of patients had never used a pedometer, and 54% described their Internet proficiency as basic or moderate.

Intent-to-treat analyses of the 37 participants enrolled in the SUH intervention showed the program was effective in helping this high-risk sample become more physically active. Paired *t*-tests showed that participants significantly increased their total daily average steps from baseline ($M = 4520$, $SD = 309$) to post-intervention ($M = 6013$, $SD = 443$), for an average increase of 1493 steps ($t(36) = 4.13$, $p < 0.01$) (Table 3). Total minutes of aerobic walking per week also increased significantly from baseline ($M = 27.0$, $SD = 8.8$) to post-intervention ($M = 71.7$, $SD = 14.7$) by an average of 44.7 minutes per week ($t(36) = 2.96$, $p < 0.01$). Most of the users found the intervention useful and easy to use (Table 3).

Discussion

Results demonstrate the feasibility of using an online clinical tool to enable PCPs to promote physical activity in high-risk patients. The developed clinical interface is a promising approach to help reorient primary care providers on lifestyle factors such as physical activity promotion [33-35]. The PCMH concept of care combines information technology tools with a collaborative team

Table 2 Baseline socio-economic and health characteristics for patient participants

N	37
Age (SD)	45.2 (9.9)
Race, % ^a	
American Indian	5.4
Black	5.4
White	91.9
Female, %	65.0
Education,%	
High School degree, GED, or less	8.2
Some College or 2-year degree	45.9
College or graduate degree	45.9
Income, %	
< \$30,000	13.5
\$30,000 - \$49,999	24.3
\$50,000 - \$69,999	16.2
> \$70,000	46.0
Marital status, %	
Married	31
Divorced	2
Single	4
Other	2
Internet Experience, %	
Basic	16.2
Moderate	37.8
Advanced	35.2
Expert	10.8
Previous Pedometer Use,%	
Yes	37.8
No	62.2
BMI (kg/m ²)	40.7 (7.6)
Currently Smoking, %	3 (8.1%)
Diagnosis,%	
Obese ^b	97.3%
Type 2 Diabetes	21.6%
Coronary Artery Disease	8.1%

^a Some participants self-identified as more than one race.

^b 100% of sample was overweight (BMI > 25) with n = 1 reporting BMI < 30.

approach to provide more time for services like physical activity counseling. Programs like SUH help support the PCMH concept of care by emphasizing the efficient application of information technology to facilitate coordination between patients and their providers [24]. SUH supports patients with personalized walking goals and feedback, facilitates ongoing patient-provider communication, and gives PCPs the ability to prospectively monitor patient progress and safety.

The SUH intervention and clinical interface have several advantages over previous strategies used to promote lifestyle change in primary care. One advantage is that the automated referral process requires minimal provider time and can reach large numbers of patients with a

Table 3 Indicators of program effectiveness

Changes in Patient Step Counts (N = 37)	Baseline Week	Final Week	p value
Average total daily steps	4520 ± 309	6013 ± 443	p = 0.0002
Average daily aerobic steps	406 ± 137	1114 ± 218	p = 0.0026
Minutes of aerobic walking/week ^a	27.0 ± 8.8	71.7 ± 14.7	p = 0.0054
Patient Satisfaction ^b (N = 34)	Mean (SD)	Agree or strongly agree	
SUH is useful	4.6 (0.7)	94.1%	
SUH increases the amount I walk	4.6 (0.9)	85.3%	
SUH is easy to use	4.7 (0.6)	94.1%	
I like working with SUH	4.6 (0.7)	88.2%	

^a Aerobic minutes of ambulatory activity are recorded by the Omron HJ-720-ITC pedometer. According to the criteria, data are recorded when an individual continuously engages in continuous movement such as walking, jogging, or running at a rate of 60+ steps per minute, involves no more than a 60-second pause, and lasts at least 10 minutes in duration.

^b Satisfaction scores are based on a 5-item Likert scale where 5 = *strongly agree* and 1 = *strongly disagree*.

consistent approach [36] in contrast to more traditional strategies such as face-to-face provider counseling [37-39] or referral by clinical staff to community programs [33,40,41]. A second advantage is that the clinical interface gives clinical providers ongoing feedback and monitoring regarding the progress of patients' walking programs. This second strength is further enhanced by the capability of patients and providers to email each other as needed so that the intervention is not disconnected from clinical practice after referral [41,42]. This is consistent with the PCMH model of care in that the primary health care team remains informed about all aspects of care.

The clinical interface provided PCPs with the option of either directly referring patients to SUH during a clinical encounter or using a clinical database to identify eligible patients to send a referral letter by mail. Over 25% of the patients referred to SUH were enrolled despite some providers expressing lack of confidence in their physical activity counseling skill. This lack of confidence is a known barrier to successful implementation of practice-based physical activity interventions [43,44]. It is possible that training programs for providers that directly address physical activity counseling skills may increase program adoption by patients. Nonetheless, use of a physical activity program by 25% of a practice network's high-risk patients could yield a significant population effect on morbidity and mortality, service utilization, and patient quality of life and optimal function.

Although providers were successful in referring patients to the program, they rarely used the clinical interface to monitor patients enrolled in SUH. This may have been due to the short duration of the follow-up period, lack of time for providers, and lack of integration of the clinical interface into the clinics' EMR infrastructure. Prior studies of automated clinical tools to support behavior change have noted that full integration of these tools with the practice EMR is desirable but

challenging. Integration allows efficient access information for patient monitoring and consultation [45].

Implementation of SUH could be improved by emphasizing a team-based approach to patient referral and by ongoing program monitoring. Involving MAs more regularly in participant monitoring might have strengthened the effect on patient adoption and use of SUH. Time constraints faced by physician providers necessitate greater reliance on nurses and MAs [24]. Furthermore, evidence suggests health behavioral change interventions are more effective when allied health personnel are trained to augment physician brief counseling and education efforts [46-49].

While the focus of this study was on testing the feasibility of the SUH as a clinical practice tool [50], Phase II testing revealed encouraging preliminary patient outcome results. Referred patients who chose to participate in the walking program significantly increased their physical activity over six weeks from an average of 45 min/wk to 72 min/wk. Despite the automated nature of the SUH walking program, participants reported high levels of satisfaction with the program. As demonstrated in previous walking studies, high-risk patients were able to successfully participate without experiencing serious adverse events [51].

This study used a combination of evaluation methods suited to assessing the feasibility of implementing an intervention in real world settings [52]. First, this study employed an iterative, user-centered design process to ensure that the clinical interface met the needs of the providers [28]. Multiple qualitative interviews with providers identified user needs and barriers to implementation that could not be easily understood using quantitative data alone [29,53]. Second, we recognized the competing priorities and time limitations faced by providers during clinical encounters and automated the SUH referral processes to minimize PCP burden. Finally, to focus on implementation rather than efficacy, there was minimal contact between researchers and provider

teams or patients during Phase II testing. Thus, provider pairs tested the system in the context of their regular clinical workflow.

Limitations

There are several study limitations worth noting. First, the study did not utilize a randomised controlled trial design with comparison to standard-of-care control participants. As previously noted, the developmental costs of many *e*-health technological interventions necessitate the use of smaller pilot studies as part of iterative research in preparation of a randomised, controlled comparative effectiveness trial (RCT). An RCT establishes clinical efficacy and cost-effectiveness in defined patient groups, but this approach was beyond the scope and aims of the current study. Notably, the current study enabled the development of a robust provider interface that lays the groundwork for SUH to be comparatively evaluated in a future RCT. Second, the short duration of this pilot intervention did not reflect real world practice where patients would be monitored over months or years versus 6-7 weeks. The short duration of the intervention may have limited provider motivation to monitor participant progress. However, the primary emphasis of this pilot study was to develop a robust clinical interface and to establish feasibility with a small sample of end users (e.g., clinical staff and patients). Third, it is also worth noting that the study did not assess changes in physiological outcomes and did not assess practical screening measures to facilitate referral to SUH. Physiological outcomes such as changes in blood pressure, cholesterol or blood glucose are key indicators of self-management outcomes. However, outcomes in this study focused on indicators of satisfaction and program engagement by the end users.

In the present study, provider pairs were engaged in the interface design process during Phase I and reviewed proposed interface implementation strategies. The providers had fewer opportunities to provide input into workflow integration issues once the interface was developed. This is a significant and fourth limitation as workflow concerns and, in particular, concerns about increased workload were frequently mentioned by providers. PCMH efforts to reorganize processes of care and improve productivity through technological innovations may have unintended consequences by actually creating additional work or causing provider dissatisfaction particularly if providers do not have the opportunity to influence practice redesign efforts [54].

Results from this study provide a foundation to build on in future investigations. In particular, more work is needed to ensure that the interface is flexible enough to accommodate a broad range of variation in workflow

patterns and to ensure intervention protocols are acceptable and feasible to providers.

As a fifth limitation, providers also complained that SUH was not part of the clinical EMR. Ideally, research intervention programs like SUH could be tested as part of the EMR and embedded with all patient medical information. This association could allow rapid comparison of program progress with changes in physiological outcomes (e.g. hemoglobin A_{1c}, lipids). In addition, electronic patient visit prompts could remind providers to inquire about program walking progress. Finally, this study sample was a small group of volunteer patients from only two family medicine clinics, which limits generalization and the statistical power of our analyses to examine the influence of factors such as patient characteristics (e.g. prior pedometer use) on the results.

Conclusions

Primary care providers can successfully refer patients to an Internet-mediated walking program using a web-based interface. Patients who chose to enroll in the program significantly increased their walking. However, providers rarely used the interface to monitor patient progress in the program. A number of barriers to provider use of the interface were identified during the program. The results of this study will enable the research team to conduct a large randomised-clinical trial to compare program results with other intervention strategies (e.g., phone, face-to-face counseling) and to evaluate the prospects for large-scale implementation of the SUH program in clinical practice.

Additional material

Additional file 1: SUH Clinical Interface Screenshots. Screenshots of Stepping Up to Health Clinical Interface.

List of abbreviations

SUH: Stepping Up to Health; PCPs: primary care physicians; PCMH: patient-centered medical home; NIH: National Institutes of Health; EMR: electronic medical record; MAs: medical assistants; RCT: Randomised controlled trial.

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Authors' contributions

DEG and CRR designed and developed the study, obtained funding, oversaw the implementation of the intervention, analyzed the data, and wrote the manuscript.

LRB assisted in the development of surveys and interview guides, acquisition of data, analysis and interpretation of qualitative data, and wrote the manuscript.

AWJ was the web interface development manager, assisted with data analysis, and reviewed the manuscript.

MDD assisted in the acquisition of data, analysis and interpretation of qualitative and quantitative data, and assisting in writing the manuscript. CWK helped with research site recruitment, provided a member check to the interpretation of qualitative findings, and reviewed many drafts of the final version of the manuscript.

VJS obtained funding, provided technical support in the development of the computerized intervention platform, and reviewed multiple drafts of the final version of the manuscript.

KZ provided expert consultation on the development of provider needs assessment interview guides, interpretation of qualitative data for development of the clinical software interface, and reviewed multiple drafts of the final manuscript.

AS obtained funding, assisted in the design, analysis, and interpretation of quantitative data, and reviewed the final version of the manuscript.

MLH oversaw the development of the clinical interface, oversaw online data acquisition, and reviewed the final version of the manuscript.

JDP obtained funding and reviewed multiple versions of the manuscript. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests. Dr. Richardson is a scientific advisor for WalkingSpree.com but does not receive any compensation.

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