HHS Public Access

Author manuscript

Gerontechnology. Author manuscript; available in PMC 2019 January 29.

Published in final edited form as:

Gerontechnology. 2017 March ; 16(1): 12–20. doi:10.4017/gt.2017.16.1.002.00.

A review of web-based chronic disease self-management for older adults

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Abstract

Objective—To examine the current evidence related to the efficacy of web-based chronic disease self-management interventions (web-based SM) for older populations.

Methods—A search of experimental and quasi-experimental publications related to older adults and web-based SM was conducted. The search identified 12 articles representing 10 distinct studies that were used for review and critique.

Results—Articles most frequently investigated web-based SM targeting diabetes and heart disease. Interventions incorporated a variety of technologies including visual-charting, instant messenger, among others. Overall the web-based SM for older adults resulted in positive effects for most outcomes, including: healthcare utilization, depression, loneliness, social support, quality of life, self-efficacy, anxiety, disease specific outcomes, functioning levels, diet, exercise, and health status.

Discussion—While these studies suggest that web-based SM may be effective in producing positive health outcomes for older adults, more research is needed to focus on the efficacy and appropriateness of such interventions for older adults.

Keywords

chronic disease; internet interventions; disease management

Many Americans suffer from chronic disease; however, the incidence of chronic conditions and co-morbidity increases with age. As the aging population is expected to grow over the next 20 years, increases in the rates and costs of chronic disease are also anticipated. In conjunction with higher illness rates, older adults are also more likely than younger adults to have multiple chronic conditions[1] and experience greater functional limitations due to chronic conditions[2]. As such, healthcare costs have been found to increase with age and number of chronic conditions[3].

With the rise of new technology, health information technologies (HIT), the exchange of health information in an electronic format[4], have been developed to improve health services, promote health, contain costs, and have claimed a prominent role in healthcare literature

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over the last decade. The expansion of the internet, e-health, and electronic communication within the health sector[5] gave way to new technologies, notably shaping the delivery of healthcare. With booming information technology, and pressure to establish cost-effective chronic disease management programming, HIT formats appear particularly appealing. This review focuses on a popular HIT chronic disease management intervention delivered through the Internet known as *web-based chronic disease self-management* (web-based SM) for older adults.

Chronic disease self-management

Chronic disease *self-management* (SM) is a term used interchangeably to mean a *process*, care behaviors and routines. It is an *intervention*, a program or service designed to support healthy behaviors and routines, and an *outcome*, healthy behaviors and care routines as a result of an intervention[6]. Although SM processes differ based on illness, common care routines include symptom recognition, medication adherence, nutrition and exercise maintenance, managing relations with family, friends and providers, and psychological response management[7]. SM interventions support SM processes using self-efficacy and self-regulation approaches, founded in empowerment and social cognitive theory, paying particular attention to patient-specific problems, improving patient problem solving, decision making, resource utilization, provider partnership formation, and action initiation[8,9]. SM empowers individuals to take responsibility in their care by handling out-patient day-to-day care, such as medication adherence, diet management, and changing and maintaining healthy behaviors[7,8]. While an exact definition of SM is not yet specified, it is commonly used in healthcare settings to indicate that individuals are active and responsible for their health[6-10].

Current evidence suggests that SM interventions improve health services, health conditions, and enhance self-care[7,8,11]. While the success of SM is well reported, challenges are documented related to the definition of SM, standards for implementation implementing, understanding the underlying mechanisms of successful outcomes, and integrating SM into healthcare systems[9,10].

Although clarification is still needed on the standardization of SM and the underlying mechanisms of positive outcomes, reviews found SM to increase self-efficacy, health status, and quality of life while reducing healthcare utilization and costs across multiple chronic conditions[12]. SM interventions decreased depression and enhanced physical functioning among stroke survivors[13]; improved pain and disability for musculoskeletal illnesses[14]; promoted diabetes, specific quality of life and clinical outcomes[15]; stimulated healthy active lifestyles and quality of life for patients with COPD[16]; augmented medication taking, social functioning, and resource utilization of heart failure patients[17]; enhanced emotional status, daily living, and self-efficacy for older adults with macular degeneration[18]; increased exercise and reduced pain among people with osteoarthritis[19]; and improved asthma health outcomes[20].

Web-based chronic disease self-management

With the rise of new technology, SM was combined with health information technology (HIT) methodologies to promote health. Web-based SM has been used in the management of, among others, heart disease, chronic obstructive pulmonary diseases, hypertension, obesity, diabetes mellitus, and asthma[21]. Several meta-analyses and systematic reviews[21-25], have yielded mixed but rather positive outcomes.

Web-based SM interventions were found to improve behavioral outcomes such as exercise and physical activity[21,26], diet[26], patient adherence[27], and weight-loss maintenance[21]. Internet interventions for depression and anxiety disorders were reported as promising self-help applications[28], and effects of web-based SM were demonstrated to reduce chronic pain[29]. Positive effects on health knowledge[26,27,30], hospitalization[31,32], and disease-specific clinical outcomes were also identified[22,23,26,31-34]. Results demonstrated improvement among psychosocial outcomes as well, including self-efficacy[23,26,27,31], social support[23], and quality of life[26,32]. Effect sizes reported for successful interventions ranged from .40 to .75[21].

Interventions that directed participants to relevant-tailored information reported increased website utilization, and those offering chat rooms had greater social support outcome improvements[21]. Particularly successful interventions included components such as linkages to an electronic medical record (EMR), computerized prompts, electronic care scheduling, and personal health records[33]. Interventions based on theory and those that used more behavioral change techniques resulted in significantly larger effects (d+=.36, CI 0.15 to 0.56), and effectiveness of interventions was also enhanced through the use of text messaging[35].

With positive effects, clearly highlighted, other reviews reported inconclusive or negative conclusions. Several authors reviewing over 60 publications between 1995 and 2005 identified efficacy concerns. Kirsch & Lewis[36] evaluated the components, utility, and efficacy, identifying few significant changes on behavioral outcomes. Norman et al.[37] and Vandelanotte et al.[38] found mixed and limited evidence related to web-based physical activity and diet interventions. Successful indicators have not yet been confirmed for asthma care[39], weight-loss[40], or smoking cessation[41], and recently Ekeland et al.[42] concluded that chronic illness telemedicine results were promising but inconclusive due to limitations and inconsistencies.

Limitations were also identified by reviewers' findings. Reviewed study designs led to inconclusive results regarding clinical outcomes[27], costs[21], data privacy and security issues[33], and economic outcomes[23]. Questions regarding long term effects and cost effectiveness[21,23] remain. Studies were also cited for lacking integration to clinical practice and discrepancies across study results[35]. Reviewers call for more research, naming these positive outcomes preliminary findings[26] in need of more high quality investigation with large sample sizes to confirm these initial findings and potential effects on different groups of people with chronic illness[23].

In addition to the limitations identified by researchers, issues of aging were not explored. Age was not specifically examined in terms of intervention efficacy for older populations. However, intervention trials did include older adults, and samples were older among diabetes, pain, and arthritis relates investigations. Evidence is currently lacking in the area of web-based SM, specifically for older adults[43]. Although web-based SM is used for health prevention and promotion among older adults, it cannot be assumed that older adults have the same needs as younger populations in regards to health management or technology use.

Methods

Searching PubMed, Cochrane Library, EBSCO Host, ACM Portal, PsychInfo, and Google Scholar using search concepts: older adults, elderly, aging, chronic disease management, web-based, computer-based, internet, online, behavioral interventions, identified 353 relevant articles. Duplicates and unavailable full articles were excluded. Articles were then narrowed to include only experimental and quasi-experimental publications, yielding 45 papers. The subsequent abstract evaluation reduced the pool to 12 articles; articles that were not specific to older adults, chronic disease management, web-based interventions and those intended for caregivers were excluded. A total of 12 articles representing 10 distinct studies comprised the final pool for review and critique of web-based SM for older adults (Table 1).

Results

Targeted health concerns

Diabetes and heart disease were the disorders most frequently targeted. The remaining studies each focused on chronic pain, COPD, multiple chronic illness, weight loss, hypertension, chronic hip issues, depression, loneliness, or physical activity.

Outcomes evaluated

Generally, the studies investigated the effects of treatment on many biological and psychosocial outcomes including: healthcare utilization, depression, loneliness, social support, quality of life, self-efficacy, anxiety, disease specific outcomes, activity/functioning levels, diet, exercise, health status, and knowledge. These outcomes are similar to the outcomes identified in the systematic reviews of web-based SM for general populations. Healthcare utilization was simply calculated by the number of visits and admissions to care. Outcomes such as depression, loneliness, quality of life, anxiety and self-efficacy used general or disease-specific validated scales. Biological factors commonly included weight, BMI, blood pressure, and cholesterol. Disease-specific interests considered A1c levels for diabetics, fatigue for heart failure patients, and pain intensity for those with chronic pain and were measured using validated scales and blood draws. Activity and function levels, diet, and exercise were measured through journals, logs, and physical activity tests. Health status and knowledge were evaluated through disease-specific subscales and self-report. Although the use of validated measures and subscales was identified throughout the articles, one article[44] did not clearly specify the measures used for changes in knowledge from pre to post testing.

Study methods

Most articles were based on randomized control trials (RCT), while only four were quasi-experimental using comparison groups. Of the RCT's, 2 were repeated measures, and one study used a waitlist control group. Univariate analysis of variance, covariance, and linear modeling were the most common statistical approaches followed by t-tests, chi-square, and multivariate analysis of variance. In general, the samples were quite small, ranging from 15 to 301 participants, with the majority being pilot investigations of about 25 to 80 participants. Participants were at least 45 years of age: one study sampled participants 45 years and older, two articles studied 50 plus, one looked at those 55 plus, and nine studies focused on those 60 years plus. While focusing on older adults, the age range for the population has yet been defined. While 45 years of age appears young, the study using this age criterion had an average sample age of 66.4 years of age, and those using 50 years were published in geriatric specific journals.

Theoretical assumptions

Few articles specified theoretical foundations for the intervention trials. Seven of the thirteen did not specifically identify a theory base; however, of those who did not specify, authors noted theoretical concepts such as health promotion, self-care, and adult learning. Other theoretical frameworks outlined by the articles included a focus on cognitive behavioral therapy, health promotion model, psychological coping, and social cognitive theory. These theories are the foundation of SM, but lack the comprehensive approach to incorporating technology and aging development.

Key components of the interventions

Using strategies founded in theory, such as cognitive restructuring, behavioral change strategies, relapse prevention, e-therapy, motivation, goal setting, problem solving, educational instruction, and support, these studies used a variety of web-based and computer mediated technologies to administer each web-based SM intervention. Technologies used included: virtual communication (virtual chats, instant messenger, video conferencing, text messaging, and email), online support groups (online group discussions, messaging boards, bulletin boards and email groups), resource portals, educational materials (e-newsletters and electronic articles), educational and learning modules, tracking tools, videos and multiple choice assessment tools. The most common web element was educational modules; all but one article incorporated at least one online health education session. Most studies included multiple web-elements while one intervention used only electronic newsletters.

Results of the studies

Overall the web-based SM for older adults resulted in positive effects on intervention groups for most outcomes. Like the results from web-based SM reviews for general age populations, knowledge was a popular outcome evaluated and was highly successful. Increases in hypertension[44], osteoporosis[45], and heart failure fatigue knowledge[46] was significantly increased after interventions. Disease-specific outcomes were also found to be successful. Chronic heart failure treatment patients had significantly lower fatigue scores and improved activity functioning[46]. Diabetes treatments resulted in significant reductions in

A1c, weight, and cholesterols levels[47], and patients with chronic pain had significant improvements in pain intensity after treatment[48]. Comparable to the general reviews these studies resulted in positive outcomes related to psychosocial factors such as quality of life[47,49], anxiety[48], depression[50,51], self-efficacy[48,50,52], loneliness[53], social support[50], and health status[49].

The reviews of web-based SM for general age populations revealed inconclusive evidence regarding the effects on outcomes such as diet and exercise. However, of the studies targeting older adults, two studies[52,54] found improvements in body weight, flexibility, cardio respiratory, and percentage of calories from fat intake after the completion of web-based SM interventions.

Only two of the articles discussed participant utilization of the specific web-elements, and the potential impact of utilization on health outcomes. Specifically, Nahm et al.[55] indicated that discussion board utilization was significantly associated with health improvements for intervention participants. Nahm et al.[45] documented that over half of the intervention participants reported that the discussion board enhanced their learning experiences. Authors did not discuss web-element utilization for emails, newsletters, nor instructional modules.

These studies also come with limitations. Small sample sizes and pilot studies reveal preliminary optimistic findings but not capable of generalization. In addition to small samples, authors note that the short time frames of the interventions may not maintain identified improvements. Attrition rates and lack of diversity within the samples are also limitations. For all of the studies, the majority of participants were white, highly educated, with high socio-economic status, and included only participants who had access to Internet, meaning that users were commonly previous computer and Internet users.

Discussion

Web-based SM is a promising intervention to support older adults' health management. However, future research is needed to support these findings and should include long-term investigation and outcomes with diverse and larger samples sizes. More randomized control trials are needed with the inclusion of testing computer variables such as technology engagement. This review suggests that there is preliminary evidence supporting the specific incorporation of online discussion boards to promote health outcomes. While this review suggests that web-based SM may be effective in producing positive health outcomes for older adults, more research is needed to focus on the efficacy and appropriateness of such interventions for older adults.

From a health perspective, older adults and their families have much to gain from web-based SM, to improve the general wellbeing of individuals, reduce caregiver burden, and provide a unique opportunity for older adults to actively engage in their health[56-59]. From economic and public health perspectives, the success of web-based SM could profoundly affect healthcare organizations and healthcare funders, particularly Medicare and Medicaid. Demonstrated intervention effectiveness and cost efficiency of web-based SM could improve the health of patients using more affordable approaches while reducing the need for clinical

and acute care. If these benefits can be demonstrated, they have the potential to mitigate the exorbitant cost of chronic illness on healthcare systems[60,61]. If successful, web-based SM could provide affordable disease management support to aid older adults to engage in healthy living and enhanced wellbeing.

Acknowledgments

This study was funded by the University of Denver Graduate School of Social Work and the Office of Graduate Studies. The author would like to thank Drs. Walter LaMendola and Leslie Hasche for their advice and support of this study.

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Table 1

Reference	Intervention & Web-elements	Design/analysis	Sample & age	Measures	Findings
44	**Intervention**: Online interactive education tool on hypertension. **Web-elements**: Instructional module; short quiz before moving to next section; 5 key audio visual	RCT; Intervention vs. control T-test	n=22; 45+	Hypertension knowledge scores (KS); demographics	Significant increase in KS for the intervention group
45	**Intervention**: Online health education and social learning. **Web-elements**: Instructional modules; discussion board; virtual chats; video-conferencing	RCT Content analysis & coding	n=245	Qualitative	Participants shared their current health behaviors and discussed specific health problems and concerns. Many recognized opportunities for improvement and identified motivators to improve health behaviors. They also offered supportive comments to others and shared helpful and practical information. More than half of the participants (n=65, 74.4%) reported that the discussion board enhanced their learning experiences.
46	**Intervention**: e-therapy group online education **Web-elements**: Instructional modules; tracking entry	quasi-experimental pretest-posttest with control group design ANCOVA; Repeated measure ANOVA	n=29	Global Fatigue Index	Lower Global Fatigue Index scores at 18th week, higher overall activity levels at 12th week, and better physical functioning at 12th and 18th week; significant gains in knowledge of fatigue management, and diminished fatigue impact on daily activities; e-therapy participants remained stable with respect to fatigue symptoms, overall activity levels and quality of life; while the control group experienced significant increases in fatigue severity and impacts, and significant decreases in activity levels, vitality, and mental health.
47	**Intervention**: Internet diabetes self-management program using behavioral and motivational strategies and cues to modify perceptions of self-efficacy; goal setting and problem solving. **Web-Elements**: Instructional module; nurse email & instant messaging support; tracking entry; weekly participant discussion boards; email reminders; resource library	RCT; Intervention vs. control MANCOVA	N=62, 60+	HbA1c testing kit, a blood pressure device with various-size cuffs, and a calibrated scale (Tanita Corp). Total and HDL cholesterol values- Cholestech LDX analyzer; Self-Administered Comorbidity Questionnaire; demographics	Significant reductions in HbA1c, weight, and cholesterol level and significant improvement in HDL levels in the intervention versus the control group.
48	**Intervention**: Online intervention 6-weeks; self- care modules; prompts and emails.	RCT; intervention, waitlist comparison ANCOVA	N=78; 55+	Health Related Quality of Life (HRQOL-14); Pain-Brief Pain Inventory-Short Form (BPI); Short Depression Scale (CES-D 10); Anxiety-6-item State-Trait	Differences in awareness of responses to pain, improvements in pain intensity and pain interference for both groups, and increases in confidence with using

Reference	Intervention & Web-elements	Design/analysis	Sample & age	Measures	Findings
	Web-Elements: Instructional modules; email reminders; nurse telephone support			Anxiety Inventory (STAI-6); Self-efficacy - Pain Self-Efficacy Questionnaire (PSLQ); self-awareness -Pain Awareness Questionnaire (PAQ); satisfaction survey	nonmedical self-care techniques to manage pain for the intervention group; Reductions in mean pain scores reported by the intervention group at log on and log off
49	**Intervention**: Web-based program for heart failure **Web-elements**: Instructional module; electronic news letters; resource library	Quasi-experimental- 2 group Repeated measure ANOVA	n=80; 60+	12-item short form (SF-12) health survey; 4-item Perceived Control (PC) Attitude Scale; demographics; computer usage	Between-group differences over time were statistically significant in the QOL mental health component and PC scores.
50	**Intervention**: Internet-based health maintenance, goal setting, problem solving, tracking, communication, and education sessions. **Web-Elements**: Instructional module; nurse email & instant messaging support; tracking entry; weekly participant discussion boards; email reminders; resource library	RCT; Intervention vs. control MANOVA/ ANCOVA	N=62, 60+	Studies Depression Scale (CES-D); Problem Areas in Diabetes Scale (PAID); Diabetes Support Scale; Diabetes Empowerment Scale (DES)	Significant improvement on measures of depression, quality of life, social support, and self-efficacy when controlling for all baseline outcome variables
51	**Intervention**: Internet-based CBT for depression Instructional modules; videos; text based CBT exercises	RCT; internet based, CBT, and waitlist control ANOVA	n=301	10-item Edinburgh Depression Scale (EDS); frequency of depressive symptoms-21 -item Beck Depression Inventory (BDI); WHO CIDI to map DSM and ICD-9 symptoms	Significant difference between the waiting list condition and the two treatment conditions; significant difference between both treatment conditions; significant proportion of participants made a change from moderate to serious symptoms at baseline to minimal to light symptoms post-treatment Internet treatment was less often completed
52	**Intervention**: Online physical activity self-management newsletters. **Web-Elements**: Internet-based electronic newsletters	RCT, Tailored Intervention vs. non-tailored ANOVA	N=21, 50-69	PA-self-report (Modified 7-day Activity Recall); Cardiorespiratory fitness- Rockport Fitness; body composition-Biodynamics Model 310e Body composition Analyszer; height, weight, flexibility-modified sit-and reach test; 29 item Benefits Scale; 14-item Barriers Scale of the exercise benefits/ barriers scales; 12 item self-efficacy for exercise habit scale	Significant time effects in flexibility and cardio respiratory; significant effects perceived barriers; self-efficacy increased; only 50 % of participants read newsletter online; 83% printed it out; no change in PA self-report
53	**Intervention**: Internet-based CBT. **Web-Elements**: Instructional module; internet access; computer lessons; home visits	Mixed-Method quasi-experimentalrepeated measures Multivariate analysis & T-tests	N=15	Loneliness scale developed by de Jong Gierveld and Kamphuis (1985); Qualitative interviews	Both groups experienced a reduction in loneliness over time; significant reductions only intervention participants
54	**Intervention**: Web-based weight loss program.	RCT; pilot 2 interventions Repeated measure ANOVA	N=21; 50-69	Block health habit and history questionnaire (HHHQ); energy	Internet delivery was feasible; 14 lost from 2% to 10% of their body weight, and 2

Reference	Intervention & Web-elements	Design/analysis	Sample & age	Measures	Findings
	Web-Elements: Instructional module; electronic news letters; resource library			expenditure-modified 7-dayactivity recall; weight, height, body fat % (TBF-215); blood pressure; cardiorespiratory fitness (VO2 max); evaluations; site utilizations	gained 2% of their weight; Large effect sizes were found over time for body weight, estimated VO2max, and percentage of calories from fat; effect sizes favoring the Web site plus peer-led support group were found for body weight, waist circumference, percent body fat, whole grain servings, and both systolic and diastolic blood pressure.
55	**Intervention**: Hip Fracture prevention website. **Web-Elements**: Instructional modules; a moderated discussion board	RCT; repeated measures, int. vs control t-test, chi-square, linear modeling univariate	N=245	Osteoporosis Knowledge Test (1) 16-item Exercise Scale and (2) 17-item Calcium Scale; Hip Fractures Knowledge Test; the Osteoporosis Self-efficacy Scale (OSE-Calcium); Self-efficacy for Exercise scale; Web-Based Learning Self-efficacy Measure (WBLSFM); 6-item Calcium Benefit subscale of the Osteoporosis Health Belief Scale; 9-item Outcome Expectations for Exercise Scale; calcium intake HHHQ; Yale Physical Activity Survey (YPAS); Perceived Health Website Usability Questionnaire (PHWUQ)	Both groups showed improvement in most outcomes. For calcium intake, only the intervention group showed improvement. None of the group and time interactions were significant. Discussion board usage was significantly correlated with outcome gains.

RCT = randomized control trial; ANCOVA = analysis of covariance; MANCOVA = multivariate analysis of covariance; ANOVA = analysis of variance; MANOVA = multivariate analysis of variance; CBT= cognitive behavioral therapy; HDL= high- density lipoproteins; TBF= Target Body Fat; WHO= world health organization; CIDI=composite international diagnostic interview; DSM= diagnostic and statistical manual; ICD= international classification of disease