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ORIGINAL RESEARCH ARTICLE

Differential Impact and Use of a Telehealth Intervention by Persons with MS or SCI

ABSTRACT

Mercier HW, Ni P, Houlihan BV, Jette AM: Differential impact and use of a telehealth intervention by persons with MS or SCI. Am J Phys Med Rehabil 2015;00:00–00.

Objective: The objective of this study was to compare outcomes and patterns of engaging with a telehealth intervention (CareCall) by adult wheelchair users with severe mobility limitations with a diagnosis of multiple sclerosis (MS) or spinal cord injury (SCI).

Design: The design of this study is a secondary analysis from a pilot randomized controlled trial with 106 participants with SCI and 36 participants with MS.

Results: General linear model results showed that an interaction between baseline depression score and study group significantly predicted reduced depression at 6 mos for subjects with both diagnoses ($P = 0.01$). For those with MS, CareCall increased participants' physical independence ($P < 0.001$). No statistically significant differences in skin integrity were found between study groups for subjects with either diagnosis. All participants were similarly satisfied with CareCall, although those with MS engaged in almost double the amount of calls per person than those with SCI ($P = 0.005$). Those with SCI missed more calls ($P < 0.001$) and required more extensive support from a nurse ($P = 0.006$) than those with MS.

Conclusion: An interactive telephone intervention was effective in reducing depression in adult wheelchair users with either MS or SCI, and in increasing health care access and physical independence for those with a diagnosis of MS. Future research should aim to enhance the efficacy of such an intervention for participants with SCI.

Key Words: Telemedicine, Multiple Sclerosis, Spinal Cord Injuries, Pressure Ulcer, Depression

Despite advances in health care, adults with spinal cord dysfunction (SCD) are living longer yet not necessarily healthier lives as they experience secondary health conditions.[1] These conditions are likely to prompt increased use of health care services and hospitalizations,[2,3] although their initial incidence also increases the risk for secondary health condition recurrence.[4,5] Individuals who acquire the skills to manage secondary health conditions may have shorter or fewer hospitalizations,[6,7] demonstrate more effective self-care and communication with health care providers,[7] and experience improved psychologic health and quality-of-life.[7,8]

Contributors to the risk for developing secondary health conditions may be directly attributed to SCD, such as impaired sensation, impaired motor function, or urinary incontinence as seen similarly in spinal cord injury (SCI) and multiple sclerosis (MS). Also understood are the influence of environmental factors such as social support, access to health care, and availability of treatment options.[9,10] Finally, health behaviors and involvement in one's care may influence secondary health conditions, in the cases of adherence to medication, preference for directing and engaging in skin care or pressure relief routines, and a person's ability to make lifestyle adjustments to potential environmental disruptors such as stress, instability of caregiver support, or equipment breakdowns.[9]

Existing community-based care for addressing secondary health conditions among adults with SCD is often delayed because of access issues[11–13] and generally focuses on treatment of existing complications with limited follow-up or preventive care.[11] Current literature shows that efforts to promote health and prevent secondary conditions among community-residing adults with SCI or MS may be enhanced with a tailored approach that acknowledges individual treatment preferences[5,12,14] and allows for well-timed delivery of relevant education and resources.[12] A telehealth intervention approach that identifies issues as they arise may be a cost-effective complement to the existing community-level services[15] and offers greater flexibility for accessing health promotion and self-management tools to adults with SCD.

Telecommunications technologies that deliver health care services are emerging as feasible and increasingly accepted tools to monitor and support self-management and health behavior change among people with chronic, disabling conditions.[16–19] Despite the efficacy of various forms of telehealth, rarely are they incorporated into standard care to support healthy behaviors and wellness among people with SCD. In response to this need for a telehealth intervention that can be widely disseminated, the New England Regional Spinal Cord Injury Center developed CareCall, an interactive, low-cost, automated phone system for adults with two forms of SCD who were experiencing severe mobility impairments.[13] CareCall uses branching logic to individualize a health and wellness promotion intervention that combines health screening and referral with cognitive behavioral counseling, peer and clinician informative vignettes, and phone follow-up from a nurse. CareCall uses a sequence of educational scripts to support self-care and health management and guides participants through the appropriate use of preventive and urgent health care.[13]

A 6-mo randomized control trial of the CareCall intervention among subjects with SCD (MS or SCI) was successful in achieving a reduction in depression severity for those who had depression at baseline, as well as an overall reduction in the prevalence of pressure ulcers among women at 6 and 9 mos after randomization.[16] CareCall participants were also found to report fewer health care access problems but did not report differences in type of services used (e.g., emergency department [ED] *vs.* outpatient) compared with control subjects who received usual care.

The authors designed CareCall to focus on secondary conditions common for persons with severe mobility limitations and hypothesized that it could be efficacious in reducing secondary conditions even if the underlying SCD diagnosis was different. Although adults with SCI and MS may present similar functional limitations and comparable risk for secondary health conditions, responses to the CareCall intervention could be quite different given demographic and clinical differences among individuals with these conditions. Therefore, this study was conceived to examine if the CareCall intervention was equally efficacious for participants with either MS or SCI in reducing the prevalence of pressure ulcers, decreasing depression severity, increasing the access to and appropriate use of preventive services, and promoting community-level participation. To better understand any differences that were observed, this study also examined the patterns of engaging with CareCall between participants with a diagnosis of MS or SCI.

METHODS

Design and Participants

CareCall participants were recruited from the greater Boston metro area through rehabilitation

medicine outpatient clinics and inpatient services affiliated with the New England Regional Spinal Cord Injury Center SCI Model System, as well as through networks of community disability organizations. Potential participants were excluded if they were at risk for self-harm, had a known stage III pressure ulcer, or had a scheduled surgery. They were also excluded if they had a severe psychiatric illness (bipolar, severe depression)[5,18] that would require present difficulties for obtaining reliable data and indicate a need for more immediate treatment beyond the scope of the CareCall intervention. Furthermore, the experienced clinical psychologist on the CareCall content development team believed that an automated system would not be appropriate to treat severe depression because of its inherent limits for individualized responsiveness. The authors excluded nontraumatic SCD diagnoses with fast progression such as amyotrophic lateral sclerosis, postpolio, and metastatic disease of the spine, as well as adults with MS who reported one or more MS exacerbations in the last 30 days although they could enroll in the study after stabilization.

The data set included 142 community-residing adults (MS, $n = 36$; SCI, $n = 106$) who had SCD. Participants used a wheelchair at least 6 hrs daily and had sufficient cognitive ability to engage with the automated phone system. Of those with SCI, 28.3% had incomplete paraplegia, 22.6% had complete paraplegia, 26.4% had incomplete tetraplegia, and 17.0% had complete tetraplegia. These adults were randomized into control and experimental groups using a stratified block randomization method to balance allocation by recruitment site (Boston Medical Center and Gaylord Hospital in Wallingford, CT), diagnosis (MS and SCI), and acute *vs.* chronic condition (SCI subsample only). Details of the study can be found elsewhere.[13,16] The study was approved by the involved institutional review boards, written informed consent was obtained, and applicable human subject protection practices were followed.

The experimental group received the 6-mo CareCall intervention of regular automated phone calls that delivered educational content and peer and clinical expert perspectives related to depression, skin care, wellness, and health care utilization modules. Call frequency was weekly for 3 mos and then biweekly for 3 mos. The system was programmed to automatically call participants at their preferred times to deliver the predetermined sequence of modules.[13] Alternatively, participants were able to call in to CareCall at any time to access the routine weekly CareCall content, complete a brief relaxation exercise, report a skin problem, or leave a message for the nurse telerehabilitation coordinator (NTC).

CareCall alerted the NTC whenever a clinically significant event was detected. Alerts were created based on decision rules developed by the CareCall development team and allowed the NTC to triage the needs of participants beyond what the automated system could determine. The NTC would call participants back within 48 to 72 hrs, depending on the severity of the alert. The NTC then provided appropriate referral, resources, or action steps for participants and used a Web-based tracking system to inform the CareCall system's feedback to participants in future calls.

Experimental group participants were given a resource book that contained diagnosis-specific and general information referenced in the CareCall scripts, as well as supplemental information of community resources related to community integration, skin care, mental health, and preparing for office visits. The control group received standard care and was issued the CareCall resource book.

The data for this analysis were collected by blinded data collectors at baseline and 6 mos by telephone and physical examinations in the participants' homes.[16] The variables examined include demographic information (age, time since injury or diagnosis, sex, education, etc.), clinical characteristics related to skin integrity, depression, health care utilization and access, participation, and satisfaction for and patterns of engaging with the CareCall system.

Study Measures

1. Depression: Self-reported depression severity was measured using the Patient Health Questionnaire-9 (PHQ-9). Participants reported the frequency of nine symptoms of major depressive disorder recognized by the American Psychiatric Association's *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (0, not at all; 1, several days; 2, more than half the days; 3, nearly every day) over the previous 2 wks. The item scores were summed and the resulting score was categorized to indicate minimal depression (1–4) or probable mild (5–9), moderate (10–14), moderately severe (15–19), or severe (20–27) depression.[20]

2. Skin Integrity: Data were collected using the Pressure Ulcer Scale for Healing tool v. 3.0 (PUSH) to measure the severity of the pressure ulcer at any areas of skin breakdown.[21] A trained nurse data collector examined the skin of each participant in person and calculated a

score for every ulcer based on the sum of values attributed to its surface area ($0 = 0$ cm^2, 10 indicates >24 cm^2), exudate amount (0, none; 1, light; 2, moderate; 3, heavy), and tissue type (0, closed; 1, epithelial; 2, granulation; 3, slough; 4, necrotic). This score generated a possible range of 0–17, with 0 reflecting no areas of compromised skin integrity and higher amounts indicating more severe tissue damage. This study measured severity of pressure ulcers of all areas of tissue damage, creating a composite PUSH score for each participant at baseline and the 6-mo follow-up examination.

3. Health care utilization: The authors collected self-reported data from the Cornell Services Index to record information on type of health care services used in the previous 3 mos (outpatient visit, hospital visit, and ED visit).[22] Question 5 from the Craig Hospital Inventory of Environmental Factors (CHIEF) was used to determine the self-reported frequency of health care access problems, asking "In the past 6 months, how often has the availability of health care services and medical care been a problem for you?"[23] Response categories were Never, Less then monthly, Monthly, Weekly, and Daily, although these values were dichotomized to "Never" and all other frequencies.

4. Participation: Participation restrictions were examined in this study using the Craig Handicap Assessment and Reporting Technique Short Form (CHART-SF) subscales of Physical Independence, Mobility, Social Integration, and Occupation.[24] Each CHART subscale includes questions about aspects of a person's societal participation within a given time frame using items such as number of hours of assistance for personal care, frequency of outings in one's community, hours spent engaged in vocational activities, and number of contacts with friends or business associates. Each subscale yields a score from 0 to a maximum of 100 indicating no handicap.

5. Engaging with the CareCall system: Calls that lasted at least 4 mins were included in these analyses, with either the participant "dialing in" or the system "dialing out." This duration was selected as the minimal reasonable length to access educational content. The participant rated the call from 1 ("least useful") to 5 ("most useful"). The satisfaction ratings according to this measure were then categorized to include 1–2 as "dissatisfied," 3 as "neutral," and 4–5 as "satisfied."

For engaging with the NTC, the authors calculated the number and length of calls. Additionally, the preprogrammed system alerts to the nurse, which are triggered by participant responses, were coded by two authors (HWM and BVH) to represent whether extensive support from the NTC was required. An alert was coded as representing a need for extensive NTC support if it occurred after the participant had been educated, offered information and support, and had made a plan with the NTC to address his or her concern. Finally, this study examined the self-reported frequency and satisfaction with using the CareCall resource book in the previous 6 mos.

Statistical Analyses

Baseline demographic and clinical characteristics were compared using univariate tests within-diagnosis analyses by study group, as well as between MS and SCI diagnostic groups. Because of the small sample size and low cell counts, Fisher's exact test values were used for all two-by-two χ^2 analyses; Pearson correlation was used for asymmetrical χ^2 analyses of categorical variables. Additionally, the response categories for certain variables were condensed because of low sample size; these included race, education level, marital status, and the CHIEF. Overall χ^2 analyses were performed for categorical variables with follow-up two-by-two χ^2 tests to determine difference between groups for each response category. The experimental group's use and satisfaction of the CareCall system were compared between diagnostic groups.

The general linear model (GLM) was used to examine the intervention effect for continuous variables (PHQ-9, PUSH, and CHART-SF), and the logistic regression model was similarly used when examining categorical variables (Cornell Services Index and CHIEF). All models were adjusted for baseline value of the outcome variable, age, and sex. Interactions between the diagnostic group and study group were also included in the models to examine whether the intervention effect was different across diagnostic groups. In the GLM, the authors examined the normality assumption by looking at the residual plot and calculating the Kolmogorov-Smirnov test; any variable with a variance inflation factor greater than 10 was indicated as multicollinearity and removed from the model. Because the bootstrap method is a statistical inference method without a distribution assumption, the authors calculated the bootstrap 95% confidence

TABLE 1 Baseline characteristics of the sample by diagnosis

	MS			SCI			Comparison between Diagnoses
	Control (n = 18)	Experimental (n = 18)	Total (n = 36)	Control (n = 53)	Experimental (n = 53)	Total (n = 106)	P (N = 142)
Demographic characteristics							
Female, % (n)	83.3 (15)	55.6 (10)	69.4 (25)	35.8 (19)	20.8 (11)	28.3 (30)	P < 0.001
Age, mean (SD), yrs	57.7 (10.1)	58.5 (7.9)	58.1 (8.9)	45.0 (14.0)	45.8 (12.1)	45.4 (13.0)	P < 0.001
Race, % (n)							P = 0.02, χ^2 = 7.67
White	100 (18)	94.4 (17)	97.2 (35)	76.5 (39)	78.4 (40)	74.5 (79)	P = 0.005
African American	0	0	0	15.7 (8)	15.7 (8)	15.1 (16)	P = 0.01
Other/declined	0	5.6 (1)	2.8 (1)	7.8 (4)	5.9 (3)	6.6 (7)	—
Ethnicity: Hispanic or Latino, % (n)	0	0	0	9.4 (5)	9.4 (5)	9.4 (10)	P = 0.065
Education, % (n)							P = 0.11
High school or less	27.8 (5)	38.9 (7)	33.3 (12)	41.3 (19)	54.3 (25)	47.8 (44)	—
Some college	33.3 (6)	33.3 (6)	33.3 (12)	35.6 (16)	32.6 (15)	34.1 (31)	—
Higher than college	38.9 (7)	27.8 (5)	33.3 (12)	23.9 (11)	13.0 (6)	18.5 (17)	P = 0.099
Presently employed, % (n)	5.6 (1)	5.6 (1)	5.6 (2)	35.8 (19)	24.5 (13)	30.2 (32)	P = 0.003
Marital status, % (n)							P = 0.10
Single	38.9 (7)	11.1 (2)	25.0 (9)	49.1 (26)	43.4 (23)	46.2 (49)	P = 0.03
Married	38.9 (7)	77.8 (14)	58.3 (21)[a]	37.7 (20)	34.0 (18)	35.8 (38)	P = 0.02
Divorced, separated, or widowed	22.2 (4)	11.1 (2)	16.7 (6)	13.2 (7)	22.6 (12)	17.9 (19)	—
Lives alone, % (n)	44.4 (8)	22.2 (4)	33.3 (12)	37.0 (17)	26.1 (12)	31.5 (29)	—
Clinical characteristics							
Years elapsed since injury or diagnosis, mean (SD)	23.5 (9.3)	22.6 (10.0)	23.1 (9.6)	12.1 (9.7)	11.5 (11.7)	11.8 (10.3)	P < 0.001
SCI level, % (n)	Not applicable						Not applicable
C1–C8				52.8 (28)	46.0 (23)	48.1 (51)	
T1–T12				39.6 (21)	50.0 (25)	43.4 (46)	
L1–L2				7.54 (4)	4.0 (2)	5.7 (6)	
SCI type, % (n)							
Paraplegia, incomplete				23.1 (12)	37.5 (18)	28.3 (30)	
Paraplegia, complete				28.8 (15)	18.8 (9)	22.6 (24)	
Tetraplegia, incomplete				32.7 (17)	22.9 (11)	26.4 (28)	
Tetraplegia, complete				15.4 (8)	20.8 (10)	17.0 (18)	

TABLE 1 (Continued)

	MS			SCI			Comparison between Diagnoses
	Control (n = 18)	Experimental (n = 18)	Total (n = 36)	Control (n = 53)	Experimental (n = 53)	Total (n = 106)	P (N = 142)
Depression							
PHQ-9 score, mean (SD)	5.9 (6.7)	4.5 (3.9)	5.22 (5.4)	4.7 (4.6)	4.6 (4.6)	4.6 (4.6)	—
Skin integrity							
PUSH summed score, mean (SD)	2.8 (6.6)	2.0 (6.2)	2.4 (6.3)	2.0 (6.2)	1.3 (3.2)	1.6 (4.9)	—
Currently has PrU, self-report, % (n)							$P = 0.001$, $\chi^2 = 14.15$
Yes	5.6 (1)	0 (0)	2.8 (1)	8.7 (4)	6.5 (3)	7.6 (7)	—
No	16.7 (3)	11.1 (2)	13.9 (5)	45.7 (21)	45.7 (21)	45.7 (42)	$P = 0.001$
Does not know	77.8 (14)	88.9 (16)	83.3 (30)	45.7 (21)	47.8 (22)	46.7 (43)	$P < 0.001$
Currently has PrU, nurse report, % (n)							
Yes	27.8 (5)	11.1 (2)	19.4 (7)	18.9 (10)	20.8 (11)	19.8 (21)	—
No	72.2 (13)	88.9 (16)	80.6 (29)	81.1 (43)	79.2 (42)	80.2 (85)	—
Health care utilization							
Service utilization last 3 mos, % (n)							
Hospital visit	0 (0)	22.2 (4)	11.1 (4)	0.9 (1)	10.4 (11)	**11.3 (12)**[b]	—
ED visit	0 (0)	27.8 (5)	**13.9 (5)**[c]	7.5 (4)	17 (9)	12.3 (13)	—
Outpatient visit	72.2 (13)	72.2 (13)	72.2 (26)	71.7 (38)	73.6 (39)	72.6 (77)	—
Frequency of access problems last 6 mos, % (n)							
Never	77.8 (14)	77.8 (14)	77.8 (28)	71.7 (38)	73.6 (39)	72.6 (77)	—
Less than monthly, monthly, weekly, daily	22.2 (4)	22.2 (4)	22.2 (8)	28.3 (15)	26.4 (14)	27.4 (29)	—
Participation							
CHART-SF subscale scores							
Physical independence	72.4 (25.7)	73.6 (26.0)	73.0 (25.5)	67.5 (35.5)	63.9 (36.3)	65.7 (35.8)	—
Mobility	70.9 (13.8)	73.0 (28.2)	71.9 (21.9)	81.6 (20.1)	74.0 (23.3)	77.8 (22.0)	—
Occupation	45.2 (29.0)	44.6 (37.1)	44.9 (32.8)	58.7 (36.9)	56.4 (41.2)	57.6 (39.0)	$P = 0.08$
Social integration	95.6 (10.1)	96.2 (9.9)	95.9 (9.9)	95.9 (13.2)	97.9 (17.1)	96.9 (14.0)	—

The only statistically significant within–diagnosis statistical findings (in boldface) are as follows: [a]More MS experimental group participants married ($P = 0.041$). More SCI Experimental group participants reported hospital visits ($P = 0.004$). [c]More MS Experimental group participants reported ED visits ($P = 0.045$).

PrU, pressure ulcer.

interval (CI) for each variable based on 5000 bootstrap samples. The Hosmer-Lemeshow test was used to examine the model fit in a logistic regression model.

Intention-to-treat analyses were completed, with 6-mo data missing for nine participants lost to follow-up. Statistical analyses were conducted using IBM SPSS version 20 and Statistical Analysis Software version 9.1.3.

RESULTS

Sample Characteristics

The authors observed several differences at baseline in demographic characteristics by diagnosis (Table 1). At 58 yrs old, participants with MS were, on average, 13 yrs older and had lived with their diagnosis for 11 yrs longer than those with SCI. There were no differences between diagnostic groups on age at time of injury or diagnosis, or whether they lived alone at the start of CareCall. Compared with those with MS, a greater proportion of those with SCI were male, African American, or single. A greater percentage of participants with MS than SCI were white, married, or reported education levels higher than college. Thirty percent of participants with SCI and only 5.6% of those with MS were employed. The only within-diagnosis difference in the MS sample was that more people in the experimental group were married compared with the control group. Within the SCI sample, there were no statistically significant demographic differences at baseline between control and experimental groups.

Depression

There were no significant main effects for diagnostic groups, although GLM results showed a significant interaction between study group and baseline PHQ-9 in predicting 6-mo PHQ-9 (R^2 = 0.68; Table 2). This indicated that those in the experimental group with moderately severe depression at baseline experienced significantly lower PHQ-9 scores at the 6-mo follow-up than those with mild or no depression. The same moderating effect of baseline PHQ-9 score was not seen for the control group. This positive effect to decrease depression severity was present for both diagnostic groups who received the CareCall intervention (Table 2).

Skin Integrity

There was no difference between diagnostic groups in skin integrity at baseline (Table 1). As for awareness of their current skin condition, close to 84% of participants with MS reported that they "did not know" if they had pressure ulcers, compared with 46% of the SCI sample. At the 6-mo follow-up, the experimental group participants with MS had completely intact skin (Table 3), although this difference was nonsignificant (P = 0.22; results not shown). In the GLM, there was no treatment effect in skin integrity noted for the participants with SCI (P = 0.76; results not shown).

Health Care Access and Utilization

Regarding health care utilization at baseline, the experimental group members with MS were more likely to report going to the ED than the MS control subjects (Table 1). Additionally, the SCI experimental group was more likely at baseline to report having been hospitalized compared with the SCI control group. After adjusting for baseline health care utilization, the logistic regression showed no treatment effects for health care utilization (hospital visit [odds ratio (OR), 0.58; P = 0.73]; ED visit [OR, 0.80; P = 0.84]; outpatient visit [OR, 1.14; P = 0.88]; results not shown).

At baseline, there was no difference between MS and SCI groups reporting health care access problems, with 22%–28% of participants reporting difficulty with health care access (Table 1). At 6 mos, the experimental group with MS reported no access issues, compared with 27.8% of the control group with MS reporting problems in the previous 6 mos (Table 3). This difference was not statistically significant in the logistic regression model (OR, 0.08; P = 0.12; results not shown).

Participation

Analysis of baseline CHART-SF subscale scores indicated that between diagnostic groups, there was a trend toward those with SCI participating more in vocational activities outside of the home than those with MS (Table 1). The GLM results indicated that CareCall's impact on Physical Independence was moderated by diagnosis (Table 4). For those with MS, CareCall had a statistically significant impact on Physical Independence; however, for those with SCI, there were no differences between experimental and control groups (P = 0.24). Regarding Social Integration, there was a trend toward an interaction between the study group and the diagnostic group (β = −10.44; 95% CI, −18.82 to −0.78; Table 5): at 6 mos, experimental subjects with MS had marginally higher scores on the Social Integration subscale (Tables 3 and 5; R^2 = 0.09) compared with the MS control group.

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TABLE 2 Predicting 6-mo PHQ-9 score from baseline score, treatment group, diagnosis, and interactions adjusted by age and sex

Parameter	Estimate	SE	t	P	Bootstrap 95% CI
Intercept	−0.78	1.53	−0.51	0.61	−3.85 to 1.67
Baseline PHQ-9	0.8	0.09	9.05	<.001	0.67 to 0.95
Study group	0.79	1.002	0.79	0.43	−0.53 to 3.07
Diagnosis	−0.31	0.98	−0.31	0.76	−2.08 to 1.41
Age	0.02	0.02	0.99	0.33	−0.01 to 0.06
Sex	−0.32	0.53	−0.6	0.55	−1.22 to 0.77
Baseline PHQ-9 × study group	−0.4	0.1	−3.83	<0.001	−0.62 to −0.24
Baseline PHQ-9 × diagnosis	0.14	0.1	1.33	0.19	−0.04 to 0.33
Study group × diagnosis	0.28	1.01	0.27	0.79	−2.16 to 1.87

Regression model notes: group (1, intervention; 0, control); diagnosis (1, SCI; 0, MS); sex (1, male; 0, female).

Engaging the CareCall System

The average length of a CareCall contact was 12.6 mins long, and the frequency of dialing in or the system dialing out did not differ significantly by diagnosis (Table 6). Participants with MS received, on average, 1.95 times more calls from the system than those with SCI; participants with MS also called into CareCall on average 1.7 times more than participants with SCI. Sixty-six percent of the SCI group had missed three consecutive weekly calls compared with only 11% of those with MS (OR, 15.56; 95% CI, 3.22–75.23). Participants in either diagnostic group reported satisfaction with the CareCall system in general and described 70% of the calls as "Most Useful."

Although the average number of NTC alerts per person was similar between diagnostic groups, alerts to the NTC that indicated a need for extensive support were more common among participants with SCI than MS (Table 6). During the 6-mo intervention, a greater percentage of those with MS (88.9%) compared with those with SCI (63.8%) referenced the resource book. Most participants reported monthly use of the resource book. Both diagnostic groups found the resource book to be helpful, with only 6.3% of those with MS and 10% of those with SCI reporting that it was not helpful.

DISCUSSION

This study compared outcomes and patterns of engaging with the CareCall telehealth intervention among participants with a diagnosis of either MS or SCI. Overall, CareCall showed a positive effect in reducing depression severity over the 6-mo intervention for participants with either diagnosis.

TABLE 3 Descriptive statistics for CareCall outcomes at 6 mos by diagnosis

	MS (n = 36)		SCI (n = 106)	
Outcome Variable	Control (n = 18)	Experimental (n = 18)	Control (n = 53)	Experimental (n = 53)
Depression				
PHQ-9 score, mean (SD)	5.1 (5.8)	2.8 (2.7)	4.0 (5.0)	3.0 (3.5)
Skin integrity				
PUSH summed score, mean (SD)	2.2 (5.9)	0 (0)	1.7 (5.5)	2.0 (6.4)
Health care utilization				
Service utilization last 3 mos, % (n)				
Hospital visit	5.6 (1)	5.6 (1)	14.3 (7)	8.5 (4)
ED use	11.1 (2)	11.1 (2)	12.2 (6)	14.9 (7)
Outpatient visit	16.7 (3)	16.7 (3)	75.5 (37)	76.6 (36)
Frequency of access problems last 6 mos, % (n)				
Never	72.2 (13)	100 (18)	75.0 (36)	85.1 (40)
Less than monthly, monthly, weekly, daily	27.8 (5)	0 (0)	25.0 (12)	14.9 (7)
Participation				
CHART-SF subscales, mean (SD)				
Physical independence	57.6 (31.4)	85.3 (12.7)	70.4 (32.2)	72.4 (34.5)
Mobility	68.7 (19.3)	76.2 (27.7)	79.4 (21.8)	79.8 (21.0)
Occupation	36.8 (24.5)	37.1 (32.5)	59.3 (35.2)	55.4 (43.5)
Social integration	91.7 (18.5)	99.9 (0.5)	96.0 (9.1)	93.3 (18.3)

TABLE 4 Predicting 6-mo physical independence score by baseline score, treatment group, diagnosis, and the interaction between treatment group and diagnosis

Parameter	Estimate	SE	t	P	Bootstrap 95% CI
Intercept	41.16	12.61	3.26	0.001	−1.45 to 62.81
Baseline physical independence	0.57	0.07	8.49	<0.001	0.47 to 0.72
Age	−0.41	0.19	−2.22	0.03	−0.78 to −0.10
Sex	−5.50	4.95	−1.11	0.27	−13.31 to 3.59
Study group	29.04	8.48	3.43	<0.001	13.76 to 45.82
Diagnosis	12.22	7.56	1.62	0.11	−1.45 to 25.77
Study group × diagnosis	−22.90	9.81	−2.33	0.02	−41.49 to −6.4

Regression model notes: group (1, intervention; 0, control); diagnosis (1, SCI; 0, MS); sex (1, male; 0, female).

CareCall increased participants' physical independence among those with MS but not for those with SCI. The significant effects of CareCall for those with MS are striking given the small sample size in this study. Analysis of process variables demonstrated that participants were similarly satisfied with CareCall, although participants with MS seemed more engaged with CareCall than those with SCI. Analyses of demographic and clinical characteristics at baseline revealed significant differences between the two diagnostic groups by subjects' sex, age, race, education level, employment status, marital status, and time since injury or diagnosis.

Participants with MS completed nearly double the amount of calls per person than those with SCI, although the average length of call did not vary by diagnosis. Although CareCall was available to participants 24 hrs a day, demands for time might also contribute to explaining why those with SCI missed more calls on average. The participants with MS may have had more free time to make calls and participate in CareCall as they were less frequently employed or engaged in other vocational activities.

CareCall alerts to the NTC indicated that participants with SCI required more extensive follow-up and individualized assistance beyond the automated intervention than those with MS. Otherwise, subjects with both diagnoses were contacted by the NTC for routine education or addressing proactive concerns at similar rates; thus, it is unlikely that this difference in alerts to the NTC was attributable to a preference for engaging with a live person *vs.* automated technology. The difference in extent of support that participants used may be explained in part by the SCI group having less experience living with their condition than those with MS. Alternatively, the difference in alerts to the NTC could represent the complexity of influences on decision making for adherence to prescribed interventions or health care advice. Comorbidities or life complications may take precedence over immediately treating or preventing secondary health conditions.[9] Finally, the need for extensive follow-up and support indicated by these alerts may also be associated with overall group differences in adherence to CareCall. The 6-mo intervention was intended to engage participants in 18 calls; those with SCI participated in an average of only 9.5 calls per person and those with MS completed 17.1 calls.

This study joins others in demonstrating participants' overall satisfaction with a telehealth intervention.[17] Still, sex differences between the MS and SCI groups may have contributed to the differential effect of CareCall on outcomes or to the distinct patterns of participating in CareCall. Men are more likely than women to ignore symptoms or delay seeking medical care.[25] Although men are generally less likely to seek preventive care or self-management

TABLE 5 Predicting 6-mo social integration score by baseline score, treatment group, diagnosis, and the interaction between treatment group and diagnosis

Parameter	Estimate	SE	t	P	Bootstrap 95% CI
Intercept	65.36	10.93	5.98	<0.001	41.13 to 84.00
Baseline social integration	0.18	0.09	2.05	0.04	0.03 to 0.43
Age	0.14	0.10	1.42	0.16	−0.05 to 0.36
Sex	2.71	2.76	0.98	0.33	−0.99 to 8.07
Study group	7.17	4.68	1.53	0.13	−1.13 to 14.55
Diagnosis	4.64	4.17	1.11	0.27	−4.04 to 11.56
Study group × diagnosis	−10.44	5.41	−1.93	0.056	−18.82 to −0.78

Regression model notes: group (1, intervention; 0, control); diagnosis (1, SCI; 0, MS); sex (1, male; 0, female).

TABLE 6 Experimental group CareCall use and satisfaction by diagnosis

Process Variable	MS (*n* = 18)	SCI (*n* = 53)	*P* (*n* = 71)
CareCall system			
System dial out			
Call length, mean (SD), mins	13.6 (5.2)	12.7 (4.5)	—
No. calls received per person, mean (SD)	8.4 (6.6)	4.3 (4.7)	*P* = 0.005
Participant dial in			
Call length, mean (SD), mins	13.7 (4.0)	14.1 (5.1)	—
No. calls made per person, mean (SD)	8.7 (8.2)	5.2 (9.1)	—
Missed 3 consecutive weekly calls, % (*n*)	11.1 (2)	66 (35)	*P* < 0.001
No. missed call alerts per person	0.3	2.2	—
Call satisfaction rating, % (no. calls)			
Least useful	7.9 (6)	7.4 (10)	—
Neutral	18.4 (14)	25.0 (34)	—
Most useful	73.7 (56)	67.6 (92)	—
NTC			
System alerts for issues requiring extensive support			
No. system alerts per person, mean (SD)	1.2 (1.5)	3.1 (2.8)	*P* = 0.006
NTC calls to participant			
Call length, mean (SD), mins	4.0 (1.5)	4.2 (2.5)	—
No. calls per person, mean (SD)	7.9 (6.5)	9.3 (6.6)	—
Resource book			
Used the resource book since issued, % (*n*)	88.9 (16)	63.8 (30)	*P* = 0.067
Frequency of use, % (*n*)			
Weekly or daily	12.5 (2)	16.7 (5)	—
Monthly	81.2 (13)	83.3 (25)	—
Satisfaction with resource book, % (*n*)			—
Very helpful	31.3 (5)	43.4 (13)	
Somewhat helpful	43.8 (7)	43.4 (13)	
A little helpful	18.8 (3)	3.3 (1)	
Not that helpful or not at all helpful	6.3 (1)	10.0 (3)	

services than they are to opt for treatment,[26] they commonly attempt to self-monitor before seeking help.[26,27] The prescriptive tone used in some CareCall scripts may be less suitable for engaging men. A recent study showed that an empathic tone was preferred for a telehealth intervention.[28] Additionally, modifications to existing content could focus on areas where men may benefit from a tailored approach, such as content that addresses barriers to incorporating healthy behaviors into daily life, recognizing and acting on signs of a secondary health condition, or addressing nonchalant attitudes regarding secondary health conditions.[9]

The implications of this study's findings suggest the need for changes in the platform for delivering CareCall content to increase its value for engaging people with SCI. Although CareCall incorporated automated vignettes from both peers and health care providers, future interventions may have greater success engaging those with SCI through more extensive use of a virtual live peer or coach. Methods using virtual coaches, live video streaming interactions, educational videos, and mobile device data collection are becoming more accessible, and perhaps more engaging, to promote health behaviors and wellness

outcomes among adults with neurologic conditions. It may also be advisable to pursue a more interactive technology platform for promoting the use of skin care behaviors among those with SCD. Phillips et al.[29] found that participants in their first year after injury who engaged in nurse-led skin care educational live video group were hospitalized for fewer days than those who engaged with the nurse through a telephone only and that both groups were hospitalized less than those who received only standard care. Live video may present the opportunity for immediate visual and auditory feedback on skin care techniques or problem-solving dilemmas.

CareCall had a positive effect of decreasing depression severity across diagnostic groups when taking into account baseline severity. Among those with moderately severe depression, there was a greater magnitude of an intervention effect noted for decreasing depression, perhaps because of a floor effect in measuring a decline in depression with the PHQ-9 among those with baseline mild or no depression. Depression is a problematic health condition for adults with SCD, interfering with participation in daily life and contributing to decreased quality-of-life and functional outcomes.[10,30,31] CareCall's effect is a

noteworthy finding supporting the health and wellness of this group. CareCall's Depression and Wellness Module is organized to detect depressive symptoms, screen for substance use problems, and promote wellness behaviors. A recent study found that individualized treatment of depression was preferred among adults with SCD.[5] Although CareCall does not replicate individualized live counseling, similar telehealth studies have been shown to decrease depression severity successfully.[29,32]

After participation in the CareCall intervention, the experimental subjects with MS had experienced increased skin integrity to the point of leaving no areas of skin damage. This is a promising trend that was not observed in the MS control group, although with this study's low statistical power, the authors were not able to demonstrate statistical significance. The trend toward intact skin integrity becomes more notable when considering that most of those with MS had not known the state of their skin integrity at baseline. Perhaps with enhanced educational intervention, cognitive behavioral techniques, and clinical support, participants with MS may come to have greater skill and self-efficacy to manage their skin care routines.

Appropriate, early responses to treat secondary health conditions may be influenced by many intrapersonal and environmental factors including mental health, competing work, family, health priorities, access to health care services and equipment, social support to engage in prevention behaviors, and knowledge.[9] Despite CareCall's integration of individualized components to acknowledge the above factors and enhance the intervention's success with adults who have unstable life circumstances or who belong to minority groups,[12] intrapersonal factors beyond knowledge are necessary to promote health behavior change. Participants who were less likely to reference the educational materials in the resource book may have missed out on the benefit of CareCall provided resources. The authors recommend further collaboration with persons with MS and SCI to facilitate addressing the multifaceted components to patient behavior change surrounding treatment in a concise and individualized way. For example, perhaps a stronger peer component may be needed to provide empathy and motivation or guidance in telehealth interventions.[12]

Health care utilization is considered to be a meter of the severity of a secondary health condition, with an admission to the ED suggesting more costly and extensive care required compared with outpatient services. Therefore, a reduction in use of ED or hospitalizations in favor of outpatient visits to achieve similar health outcomes would be indicative of more effective patient monitoring and patient self-management of health. There are mixed reports about how telehealth influences health care utilization,[15] acknowledging that health care access issues also need to be considered. Individuals who do not use routine health care may be exceptionally healthy, or they may have limited access to services or resources such as stable personal care providers or transportation.[12] In this study, at 6 mos, there were declines in the percentage of participants with MS in the experimental group who went to the ED as well as the percentage of experimental participants with SCI who were hospitalized, whereas both of these rates increased for the respective diagnosis control groups. Although these changes in health care utilization frequency did not produce statistically significant treatment effects, they may reflect emerging benefits of a telehealth intervention to inform and support problem-solving efforts to prevent a hospitalization and access the appropriate health care services when needed.

CareCall has the potential to bypass health care access barriers for adults with SCD through in-home delivery of the individualized, automated, telephone-based intervention and could be widely distributed through disability organizations. Although the MS experimental group reported no access issues after the 6-mo intervention, regression analyses did not reveal statistically significant differences from the MS control group. CareCall participants were coached with the Health Care Utilization Module and provided with resources, care coordination, and encouragement to interact with health care clinicians and seek appropriate community-level services. For people with chronic conditions such as MS and SCI, effective health care may also require that the individual and primary caregivers be included as experts in his or her care. Common health care access issues are due to insurance coverage, structurally inaccessible treatment facilities, appointment scheduling, or even misconceptions about health care services. Further research is recommended to determine what specific supports minimize barriers to health care for adults with MS or SCI.

The items used to measure physical independence with the CHART-SF include the number of paid and unpaid daily hours of assistance required for completing personal care (such as eating, bathing, dressing, toileting, and mobility). Although it was not a primary outcome of the CareCall randomized control trial, it is notable that participation in CareCall supported gains in perceived physical independence among those with MS. The decreased need for assistance among CareCall participants with MS could

lead to increased quality-of-life,[33] decreased caregiver burden, or overall enhanced participation in daily life. Depression severity has been correlated with physical independence,[34] and results of a telephone-administered cognitive behavioral therapy intervention produced decreases in depression and associated decreased perception of disability for people with MS.[19]

There are several limitations to this study that should be noted. This study had a small sample size, particularly among the group with MS, which may have decreased the possibility of finding treatment effects within the diagnostic group. The results of this study should be confirmed by future studies with larger sample sizes or combined with other telehealth study findings through metanalysis. A second limitation is that there was no way to determine the impact of MS subtype or disease-modifying treatment as these data were not collected as part of the CareCall study. Even so, having randomized participants to either experimental or control group serves as a control for known and unknown confounders.

CONCLUSION

This study extends previous research by revealing that an interactive telephone intervention can be an effective and accepted intervention to improve depression for adults with MS and SCI and to enhance health care access and physical independence for those with MS. Future research should aim to enhance adherence and efficacy for adults with SCI and to explore the delivery of CareCall through other more innovative forms of mobile technology. CareCall addresses contemporary recommendations to increase health care in the community context with patient education and health behavior change, using a unique telehealth complement to standard care. Aligning with the patient-centered focus of health care professions, this study emphasizes the need for addressing the multifaceted individual with SCD and his or her environment to support community-based care for secondary health conditions.

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