

## Predictors of Successful Acceptance of Home Telemanagement in Veterans with Multiple Sclerosis

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**Abstract**— Modern telehealth technologies may be instrumental in overcoming the barriers of optimal care delivery for patients with MS. However, the significant potential of telemedicine approaches in improving MS care has not yet been fully explored. The Multiple Sclerosis Centers of Excellence of the Department of Veterans Affairs (VA) has been actively promoting the use of telemedicine in helping veterans with MS. Particular attention was given to the development of cost-effective care coordination solutions which can be easily delivered directly to each veteran home via internet and accessed via a regular computer or a mobile device. In this article, the design of the MS HAT system is introduced and results of the initial feasibility evaluation are presented. The feasibility of the MS HAT system was assessed by (1) analyzing attitudinal surveys of veterans with MS who used the MS HAT system at home for over a month; (2) identifying factors affecting acceptance of the MS HAT system; (3) reviewing adherence of MS HAT users to self-testing regimen; (4) analyzing veteran feedback on MS HAT functionality using semi-structured qualitative interviews.

### I. INTRODUCTION

Multiple Sclerosis (MS) is a chronic neurodegenerative disease of the central nervous system which may result in significant damage of the neuromuscular system, limited mobility, and impaired vision, cognitive and affective functions. More than 400,000 persons in the United States have MS, including over 28,000 veterans [1]. In 1998, the annual cost of MS in the US was estimated at \$6.8 billion, and a total estimated lifetime cost per case was \$2.2 million [2]. Lifelong disease modifying therapy and continuous comprehensive rehabilitation measures are the major components of patient management. Therapeutic exercises have a positive impact on patient quality of life and their functional capacities. Poor adherence to medication and rehabilitation regimen, limited patient education and challenges with timely access to specialized care can be barriers to treatment [1].

Modern telehealth technologies may be instrumental in overcoming the barriers of optimal care delivery for patients with MS. However, the significant potential of telemedicine approaches in improving MS care has not yet been fully explored. The Multiple Sclerosis Centers of Excellence of the

Department of Veterans Affairs (VA) has been actively promoting the use of telemedicine in helping veterans with MS. Particular attention was given to the development of cost-effective care coordination solutions which can be easily delivered directly to each veteran home via internet and accessed via a regular computer or a mobile device. In this article, we describe our initial experience in real-life implementation of such a system.

The approach utilized in this project for implementing a comprehensive telecare solution for veterans with MS was based on our successful experience in using Home Automated Telemanagement (HAT) in other chronic conditions [3-5]. The HAT system is designed to support current recommendations on using telehealth programs for care delivery to veterans. In a recent article [6], telehealth programs for veterans were defined as “the provision of healthcare and sharing of medical knowledge through telecommunications.” It was indicated that veterans are often isolated because of their disability or location, and telemedicine can significantly improve access to medical care for them.

In this article, the design of the MS HAT system is introduced and results of the initial feasibility evaluation are presented. The feasibility of the MS HAT system was assessed by (1) analyzing attitudinal surveys of veterans with MS who used the MS HAT system at home for over a month; (2) identifying factors affecting acceptance of the MS HAT system; (3) reviewing adherence of MS HAT users to self-testing regimen; (4) analyzing veteran feedback on MS HAT functionality using semi-structured qualitative interviews.

### II. METHODS

#### A. System Design

MS HAT has been designed (1) to assist providers in prescribing individualized self-care plans for patients with MS according to the current evidence-based guidelines; (2) to support patients at home in following their individualized self-care plans; and (3) to facilitate patient-provider communication. The MS HAT system is an extension of the Home Automated Telemanagement system which has been shown to successfully facilitate disease management in various chronic conditions [3-5]. MS HAT features include patient self-care, tailored education and counseling, individualized treatment plans, guideline-concordant decision support, comprehensive patient provider communication, and multidisciplinary care coordination [5]. Patients can access the MS HAT system via multiple health communication channels including desktops, tablet PC, cell phones, and gaming platforms such as Wii or PlayStation. User-friendly interface supports access of patients with

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limited locomotion, vision, or cognition using touch screen, mouse, keyboard, or voice depending on the user preference.

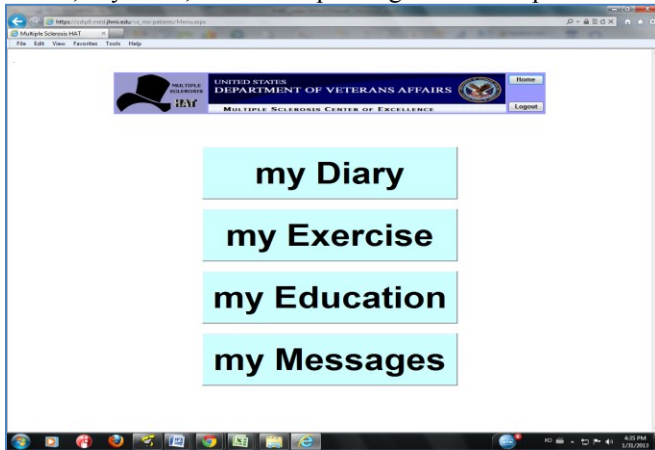


Figure 1. MS HAT Patient Portal: Main Menu

The MS HAT supports the following system components: 1) web-based guided self-management portal for patients; 2) central data repository with clinical decision support server connected with electronic medical record; 3) computerized disease management and care coordination portal for clinical care coordination team. The interface for the website is designed with minimal requirements for its users. The patient portal supports interfaces allowing veterans with disabilities to fully use the site. The decision support server provides tools for setting up individualized patient alerts, tailored disease management plans, and coordination of care between multiple providers.

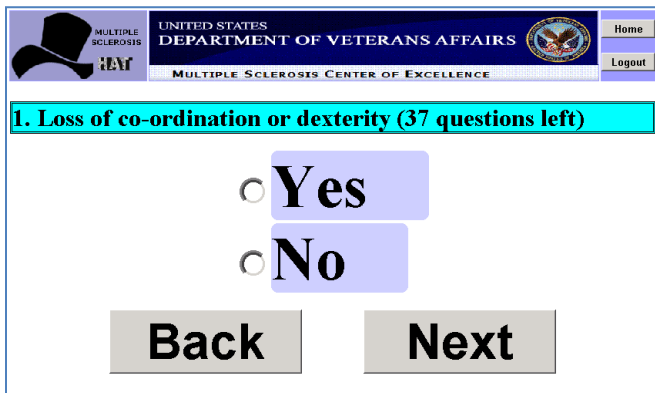


Figure 2. MS HAT Patient Portal: Symptom Diary

At the start of a self-testing session, after agreeing to the terms of use the MS HAT patient portal, patients access a main menu with 4 options: 1) my Diary; 2) my Exercise; 3) my Education; 4) my Messages as seen in Fig. 1.

When the patient begins the daily diary, they are asked a series of multiple choice questions about their health over the past 24 hours as seen in Fig. 2. Once the symptom diary questions are answered, the patient will be asked individualized questions about medication side effects setup by their care provider in the MS HAT clinician site, then the patient is asked to complete periodically scheduled surveys. Side effects and survey questions are personalized and are specified by the care provider on the clinician site.

After all diary, side effect, and survey questions are answered, the patient is shown an educational message about MS with a corresponding image. To ensure comprehension of the educational message, the patient is asked a simple multiple choice question about the message they received during the following self-testing session. If the question is answered correctly, the next educational message is presented, otherwise the previous message is repeated next time. All educational messages are sequenced from basic facts to more complex topics from MS care curriculum. At the end of the self-testing session, all data are transmitted to the HAT decision support server to be analyzed according to individually setup alerts and reviewed by their care provider.

By selecting the “my Exercises” option the patient can review any currently prescribed exercises as seen in Fig. 3. The list of exercises is customized by the care provider on the patient portal.

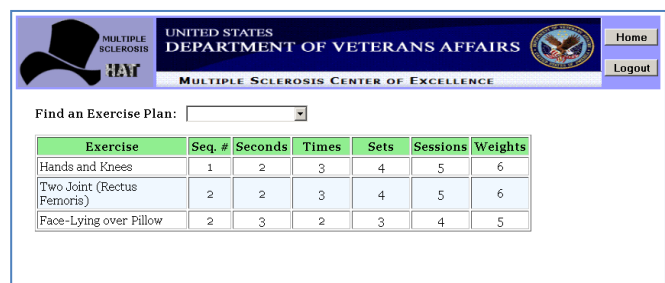


Figure 3. MS HAT Patient Portal: Exercise Regimen

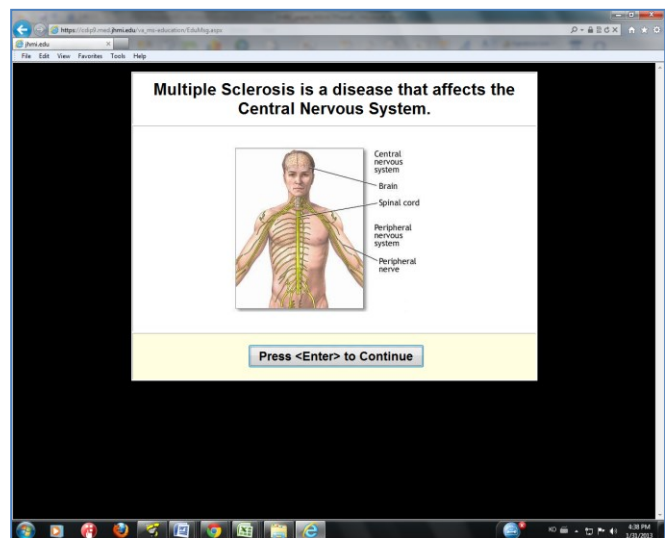


Figure 4. MS HAT Patient Portal: Interactive MS Education

Selecting the “my Education” option takes the patient to the MS HAT education portal. Here the patient can complete an electronic educational curriculum on MS HAT. The portal gives the patient an educational tip as seen in Fig. 4 and questions them as it does at the end of the diary. After the tip is answered correctly they move on to the next tip in the educational section. Once the section is completed the patient takes a short quiz about the section without receiving the tips first. The quiz questions are a subset of the educational questions. If all questions are answered correctly, they move

on to the next section, otherwise they repeat the section until the quiz is passed. The educational curriculum can be printed or browsed in the “Frequently Asked Questions” mode.

The patient can also send and receive messages to their care provider through the “my Messages” option as seen in Fig. 5. Here the patient can type in a message to their care provider or review messages sent by their care provider. Messages sent to the provider are sent to the HAT server immediately and generate an alert on the clinician site for the care provider.

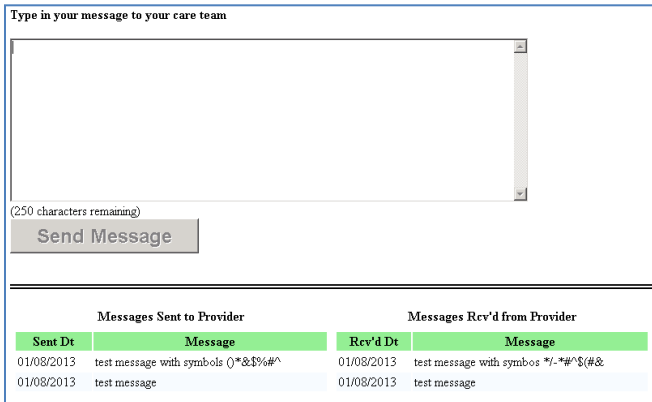


Figure 5. MS HAT Patient Portal: Messaging Site

The MS HAT clinician site allows the patient’s care provider to securely view diary data, prescribe exercises, assign surveys, generate customized alerts, send messages, and monitor medication side effects.

The patient’s symptom diary, side effects, and survey results can be viewed on the site as seen in Fig. 6.

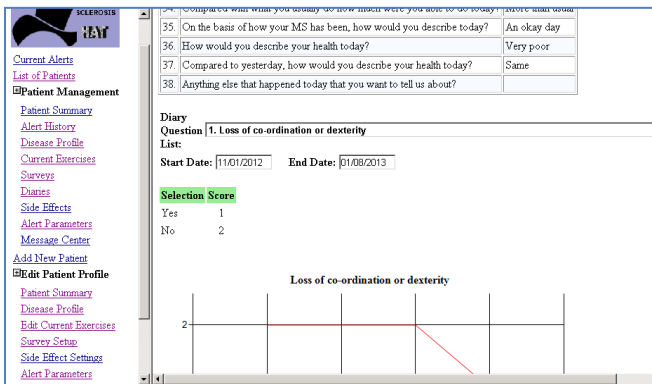


Figure 6. MS HAT Clinician Site: Patient Self-Testing Results

The physician portal allows surveys to be assigned for the patient to complete at specified times as seen in Fig. 7. The care provider can also assign which medication side effects are asked about in the diary.

Care providers can send messages to the patient before they begin their diary and assign personalized alerts for each patient. Alerts can be generated when a patient does not complete a scheduled survey or based upon their diary results. All patient information set on the portal is immediately changed on the server and will be changed the next time the patient logs in to the patient portal.

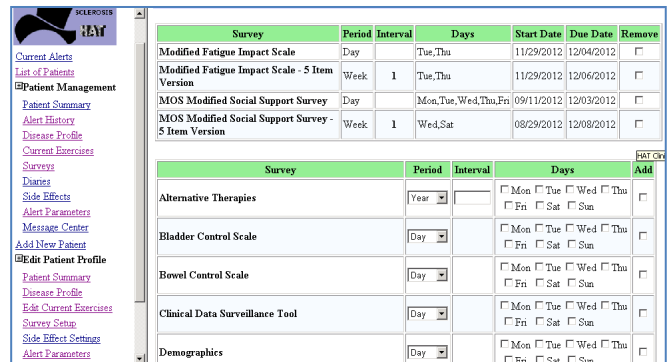


Figure 7. MS HAT Clinician Site: MS HAT Survey Prescription Pad

TABLE I. DEMOGRAPHICS

N=20	N	%
<b>Age (years)</b>	53.9 ± 10.0	Range: 36-76
<b>How long have you had the illness? (years)</b>	14.5 ± 8.3	Range: 0.25-30
<b>Race</b>		
White	8	40.0
African American	12	60.0
<b>Your MS symptom severity in the last month:</b>		
None	1	5.0
Mild	6	30.0
Moderate	10	50.0
Severe	3	15.0
<b>Internet use</b>		
Once a day	16	80.0
Once a week	3	15.0
Once a month or less	1	5.0
Never	0	0.0
<b>Computer use at home</b>		
Once a day	17	85.0
Once a week	3	15.0
Once a month or less	0	0.0
Never	0	0.0
<b>English skills</b>		
Excellent	14	70.0
Good	6	30.0
Poor	0	0.0
None	0	0.0

TABLE II. MULTIPLE SCLEROSIS SUBTYPE

Subtype	N	%
Primary Progressive	3	15.0
Relapsing Remitting	6	30.0
Secondary Progressive	11	55.0

### B. Pilot Testing

A total of 20 consecutive patients with MS were recruited from Washington DC VA Medical Center. The potential study participants were approached by the clinical staff at the MS clinic. First, the research staff visited the patient’s home and provided a training session on how to access MS HAT from their home computer. The link to the website, user ID and password was given to each patient. During the home visit, a set of questionnaires were administered to collect information about demographics and self-care strategies. Then the patients were asked to use the MS HAT for at least one month preferably on a daily basis. The data was transferred via secure internet network to a care management web site. At the end of 1-2 month follow-up, an exit interview was conducted either

at patients' home or at the MS clinic at VA Medical Center. MS HAT acceptance was ascertained by a semi-structured qualitative interviews and attitudinal surveys collected at the end of the study. A regression model with acceptance score as a primary outcome was used to identify factors affecting acceptance of MS HAT. The model included age, race, years of education, years of having MS, English proficiency, Expanded Disability Scale Score (EDSS) and frequency of computer use at home. Statistical analyses were performed using SAS version 9.0.

### III. RESULTS

The mean age of participants was 54 years old (53.9±10.0) and they had MS on average for 15 years (14.5±8.3), 70% were men, 60% were African Americans, 85% used computer at home, and 80% reported internet use on a daily basis. The initial training session lasted on average 26.6±8.9 minutes. The mean EDSS score was 5.3±2.3 ranging from 1.0 to 8.0; 15% of participants had Primary Progressive MS, 30% - Relapsing Remitting, and 55% - Secondary Progressive MS. The mean Attitudinal Survey Score was 75.5±9.5 ranging from 56 to 92 with perfect score being 92 (higher score indicated more positive acceptance to the MS HAT system).

Based on the linear regression model, less years of having MS, computer use at home once a week or less, and better English proficiency were significant factors for MS HAT acceptance. As the years of having MS increases, we expect approximately 0.9 points decrease in the Attitudinal Survey Score. For those who use computer at home once a day, the predicted Attitudinal Survey score would be 20.1 points lower than those who never used it, used it once a month or once a week. For those who speak excellent English, the predicted Attitudinal Survey score would be 16.3 points higher than those who have good, poor or no English skill. Age, race, years of education and gender did not show statistically significant association with the acceptance score.

TABLE III. LINEAR REGRESSION

Attitudinal survey score	Parameter estimates	T value	P value
<b>How long have you had MS? (years)</b>	-0.9	-2.9	0.02*
<b>Age</b>	0.2	0.5	0.6
<b>Computer use at home</b>	-20.1	-3.5	0.007*
Never/Once a month or less/Once a week (0)			
Once a day (1)			
<b>English proficiency</b>	16.3	4.0	0.003*
Excellent (1)			
Good/Poor/None (0)			
<b>Education (years)</b>	-0.7	-0.9	0.4
<b>Race</b>	-5.1	-0.9	0.4
White (0)			
African American (1)			

Patient login rate varied from near 100% to less than 50% depending on a participant with average self-testing adherence 52%. The weekly log-in rate decreased from 100% on the first week to 56% on the second week. Then the log-in rate returned back to 75% on the third week in part due to the patient reminder calls. Decreasing self-testing adherence trend was observed until the final week 9 when 31% of participants accessed the MS HAT website for self-testing.

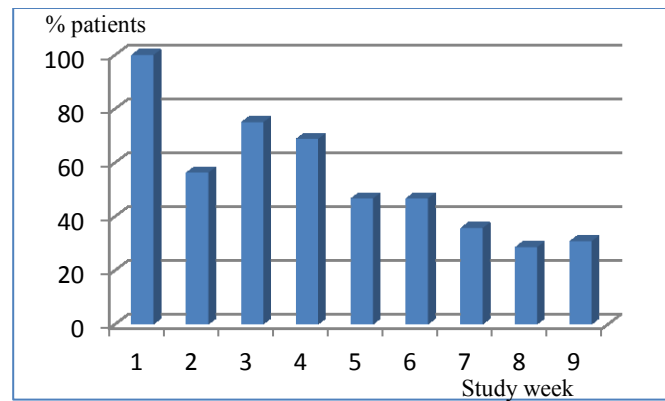


Figure 8. Weekly log in rate

Semi-structured qualitative interviews demonstrated high acceptance of the MS HAT system. Symptom diary was perceived as a useful tool by most of the patients. As one participant stated, “My symptoms may disappear by the time I meet my doctor. MS patients have memory problem, too. If I don’t record it, I will forget to tell my doctor. It keeps you mindful and aware of your condition.” (ID #2) The interactive patient education was also well received as another veteran explained, “Education was cool. It’s good because based on the answers, doctor can decide if patient needs to be re-educated.” (ID #6) The patients were comfortable using MS HAT for self-care, as another patient indicated, “Using the computer was easier than using the remote control.” (ID #1)

### IV. DISCUSSION

The MS HAT system was well accepted by veterans with MS regardless of education level, race or gender. Though the veterans demonstrated overwhelming support of the general concept of home telemanagement, their use of the system significantly decreased over the time. From the qualitative interviews, the main reason for this was lack of tailored patient-specific content and individualized feedback. Tailoring this technology to patient needs, values, and preferences may facilitate its use by veterans with MS.

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