Exploring the Feasibility of Gait Monitoring and Falls in the Homes of Persons with Multiple Sclerosis

Pamela Newland, RN, PhD, CMSRN, [1] Alyssa Kimutis, BSN (c),[1] Joanne Wagner, PT, PhD[2], Amber Salter, PhD,[3] Florian Thomas, MD, MA, MS, PhD[4]
[1]Goldfarb School of Nursing at Barnes Jewish College; [2]Physical Therapy, Saint Louis University, Acorda Therapeutics, Ardsley, NY, [3]Washington University Biostatistics, [4]Saint Louis University, Neurology

Introduction

- Due to the progressive nature of the disease, persons with MS (PwMS) experience worsening symptoms and gait variability, which places this population at a high risk for falls.
- Studies have shown that gait characteristics may be analyzed to assess fall risk in addition to being a diagnostic marker of progression. (Benedetti et al. 2012**;** Galli et al, 2015**)**
- The use of a monitoring system in the homes of PwMS may allow for targeted gait and symptom management, fall prevention strategies, and early treatment for symptom and disease progression.

Objectives

- The objective of this study was to describe the feasibility and validity of depth sensors to monitor gait and falls in the homes of PwMS over a period of 30 days.

Methods

- Subjects were recruited from a MS clinic in the Midwest and from a database of previous research participants.
- The inclusion criteria were: internet access, age 18 years or above, diagnosis of any subtype of MS, no relapse in the prior 30 days, Self-Report Expanded Disability Status Scale (SR-EDSS) score of 0 to 6.5. We also included and screened for self-reported ≥ 2 falls in the last 6 months.
- A 16-foot GaitRite electronic pathway (Fig 1) was used to calculate in-laboratory spatiotemporal parameters of gait (gait speed (cm/s), stride length (cm), and stride time(s) during a timed 25-foot walk.

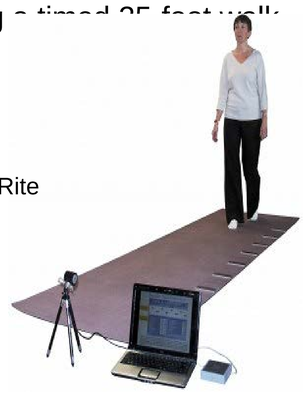

Figure 1. GaitRite

http://www.emsphysio.co.uk/32_gaitrite-platinum.htm

Methods (cont.).

- Clinical gait measures: Timed-Up and Go, Timed 25-foot walk test (T25FWT), and the Six minute walk test (6MWT).
- To validate fall risk with the sensor system, each participant completed a 30-day fatigue/pain/fall log.
- In home-gait systems using the depth sensors were installed in the main living area of each home (Fig. 2) (SensorForesite Patientcare™ System) (Rantz et al, 2014)
- The depth image was processed to compute gait parameters of stride time, stride length, and velocity.
- The average in-home gait speed (AIGS) of a subject for a given day was computed as a weighted average of gait speed from all segmented walks in their home during the prior seven days.

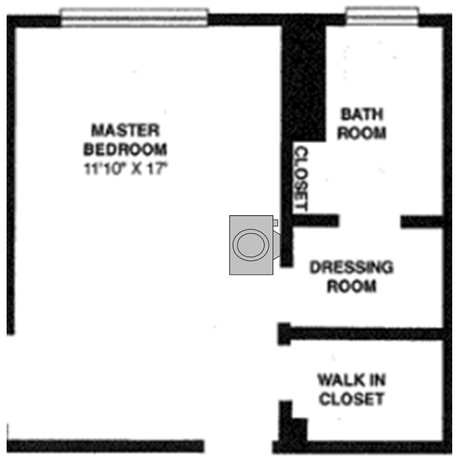

Figure 2. Example blueprint of in-home sensor placement in one PwMS apartment.

Sample Characteristics

Table 1. Demographic and Clinical Sample Characteristics

Sex, n (% n) Female Male	 4 (57.1) 3 (42.9)
Race, n (% n) White African American	 5 (71.4) 2 (28.6)
Age (years), mean (SD)	50.7 (9.2)
Years since diagnosis, mean (SD)	12.2 (8.2)
Self-report EDSS, median (IQR)	5 (4.5, 6.0)

MS Walking Scale-12, median (IQR)	62.5 (60.4, 68.8)
Timed 25 foot walk (seconds)	7.6 (7.1, 8.5)
6 Minute Walk (feet)	1587 (450,1188)
Timed Up and Go (seconds)	15.5 (13.8, 20.4)

Results

21 PwMS were contacted about participating in the study.

- Six failed screening due to not meeting fall eligibility, and one subject did not qualify due to having a relapse.
- Seven PwMS did not want to participate due to privacy concerns.
- A final total of seven PwMS participated (Table 1.)
- Four PwMS reported postively during interview on the acceptibiliy of the sensors as method to detect gait and falls.
- Four subjects had 30 days of continuous recordings.

Table 2. Sensor measures over the first 30 days of study.

Pt	Number of days recorded	Speed (cm/sec)	Stride Time (sec)	Stride Length (cm)	TUG	Mean Walks per day
1	27	177.9	43.5	1.5	65.2	20.9
2	30	160.4	63.3	1.3	79.4	14.1
3	30	151.7	40.0	1.9	72.6	24.7
4	5	139.8	61.6	1.3	76.7	14.2
5	30	175.2	66.8	1.4	91.0	13.8
6	18	161.3	77.4	1.4	104.8	13.5
7	30	161.1	70.2	1.3	91.0	13.7

Conclusion

- Our study has the strength of the positive interview feedback from the participants as to the usefulness of these sensors for future studies.
- Limitations included small sample size, sensor placement limitations in capturing falls, and privacy concerns.
- This technology has the potential to provide an accurate and measure of in home gait parameters in PwMS, leading to improved detection of disease progression.

References

Benedetti , M.G., et al. Self-reported gait unsteadiness in mildly impaired neurological patients: an objective assessment through statistical gait analysis. J Neuroeng Rehabil. 2012.

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CMSC

BARNES JEWISH College Goldfarb School of Nursing
BJC HealthCare