Published in final edited form as:

Phys Occup Ther Geriatr. 2014 June ; 32(2): 169–178. doi:10.3109/02703181.2014.915282.

Patient Active Time During Therapy Sessions in Postacute Rehabilitation: Development and Validation of a New Measure

Helen H. Host, Catherine E. Lang, Mary W. Hildebrand, Dequan Zou, Ellen F. Binder, Carolyn M. Baum, Kenneth E. Freedland, Nancy Morrow-Howell, and Eric J. Lenze

¹Program in Physical Therapy, Department of Internal Medicine, Washington University School of Medicine, St. Louis, Missouri, USA

²Department of Occupational Therapy, East Carolina University, Greenville, North Carolina, USA

³Program in Physical Therapy, Department of Radiology, Washington University School of Medicine, St. Louis, Missouri, USA

⁴Division of Geriatrics and Nutritional Science, Department of Internal Medicine, Washington University School of Medicine, St. Louis, Missouri, USA

⁵Program in Occupational Therapy and Neurology, Washington University School of Medicine, St. Louis, Missouri, USA

⁶Department of Psychiatry, Washington University School of Medicine, St. Louis, Missouri, USA

⁷School of Social Work, Washington University, St. Louis, Missouri, USA

Abstract

Background and purpose—The accurate measurement of therapy intensity in postacute rehabilitation is important for research to improve outcomes in this setting. We developed and validated a measure of Patient Active Time during physical (PT) and occupational therapy (OT) sessions, as a proxy for therapy intensity.

Methods—This measurement validity study was carried out with 26 older adults admitted to a skilled nursing facility (SNF) for postacute rehabilitation with a variety of main underlying diagnoses, including hip fracture, cardiovascular diseases, stroke, and others. They were participants in a randomized controlled trial that compared an experimental high-intensity therapy to standard-of-care therapy. Patient Active Time was observed by research raters as the total

© 2014 by Informa Healthcare USA, Inc.

DECLARATION OF INTEREST Dr. Lenze has research support from Lundbeck and Roche. The other authors report no potential conflicts. The sponsor, NIMH, had no role in the analyzing of data or writing or review of this publication.

ABOUT THE AUTHORS Dr. Lenze has received research support from Roche, Johnson & Johnson, Lundbeck, and Forest Laboratories. Dr. Binder is a consultant for Eli Lilly and Regeneron Pharmaceuticals.

Suppliers

- a. Miniature 3-axis accelerometer data logger X6–2mini set at high Gain with sampling rate of 40 Hz. Gulf Coast Data Concepts, LLC, 611 Nicholson Ave., Waveland, MS 39576 USA;
- b. Mathworks, 3 Apple Hill Drive, Natick, MA 01760–2098 USA;
- c. Systat version 13.0, Systat Software, Inc. 225 W. Washington St., Ste 425, Chicago, IL 60606.

number of minutes that a patient was actively engaging in therapeutic activities during PT and OT sessions. This was compared to patient movement (actigraphy) quantified during some of the same PT/OT sessions using data from three-dimensional accelerometers worn on the patient's extremities.

Results—Activity measures were collected for 136 therapy sessions. Patient Active Time had high interrater reliability in both PT ($r = 0.995, p < 0.001$) and OT ($r = 0.95, p = 0.012$). Active time was significantly correlated with actigraphy in both PT ($r = 0.73, p < 0.001$) and OT ($r = 0.60, p < 0.001$) and discriminated between a high-intensity experimental condition and standard of care rehabilitation: in PT, 47.0 ± 13.5 min versus 16.7 ± 10.1 min ($p < 0.001$) and in OT, 46.2 ± 15.2 versus 27.7 ± 6.6 min ($p < 0.001$).

Conclusions—Systematic observation of Patient Active Time provides an objective, reliable, and valid index of physical activity during PT and OT treatment sessions that has utility as a real-world alternative to the measurement of treatment intensity. This measure could be used to differentiate higher from lower therapy treatment intensity and to help determine the optimal level of active therapy time for patients in postacute and other settings.

Keywords

Physical therapy; occupational therapy; rehabilitation; skilled nursing facilities; intensity

INTRODUCTION

One tenet of medical rehabilitation is the importance of treatment intensity in physical therapy (PT) and occupational therapy (OT) sessions. This issue is particularly relevant in postacute rehabilitation for two reasons. First, treatment intensity is determined by site of care. Postacute rehabilitation in an inpatient rehabilitation facility is considered more intensive than in a skilled nursing facility (SNF) because more time is spent in daily PT and OT sessions (Munin et al., 2010). Second, more scheduled therapy time is associated with better functional outcomes in older adults who have suffered disabling medical events such as stroke and hip fracture (Jette et al., 2005; Kwakkel et al., 1999; Munin et al., 2005; Outermans et al., 2010; Singh et al., 2012). From this it has been inferred that higher intensity postacute rehabilitation produces better outcomes, and therefore, higher (or more optimal) therapy intensity is itself a goal of research and quality improvement efforts in this setting (Chan, 2007).

However, hours of scheduled therapy time may be an inaccurate measure of intensity, as patients may be inactive during significant proportions of their scheduled therapy sessions (Bohannon, 2003; MacKay-Lyons & Makrides, 2002; Talkowski et al., 2009). At present, there is no set threshold for PT or OT session intensity in most settings, nor is there a consensus for measuring intensity. Currently, the only intensity guidelines for the postacute rehabilitation setting are for inpatient cardiac and stroke rehabilitation (Gordon et al., 2004; Joo et al., 2004; Kluwer, 2010) and these guidelines pertain only to aerobic exercise. These guidelines prescribe an intensity range of 40 to 60% of maximal oxygen uptake level; the measurement of which is difficult in many postacute rehabilitation settings. Because the typical postacute rehabilitation setting has a range of impairment groups, comorbidities

(including cognitive and emotional impairments), functioning, and therapeutic activities, a physiological measure of intensity may not be feasible and valid for research in this sector. In addition, increasingly postacute rehabilitation is carried out on the oldest old (Idland et al., in press) for whom physiological measures may not be as relevant.

An alternative to measuring intensity is quantifying the amount of time a person is active during each therapy session. For example, some of us have quantified amount of therapy for stroke and traumatic brain injury by counting repetitions (Kimberley et al., 2010; Lang et al., 2007; Lang et al., 2009). Similarly, a few studies have used accelerometry to measure movement during rehabilitation as an estimate of treatment amount (Choquette et al., 2008; Talkowski et al., 2009). While this may have some limitations in judging intensity (e.g., a patient may be active throughout a therapy session but still have relatively low intensity), it potentially has significant advantages in feasibility of measurement in a sector of care that has a heterogeneous group of patients.

Our research group recently developed an objective measure of therapy activity, Patient Active Time, as a real-world alternative to physiologic measures of therapy intensity. We measured Patient Active Time during an intervention development project which tested “Enhanced Medical Rehabilitation,” a set of patient engagement skills for PT and OT to increase the intensity of therapy sessions in postacute rehabilitation (Lenze et al., 2012; Lenze et al., 2013). The purpose of this research report is to describe the validity of measurement of Patient Active Time. We hypothesized that Patient Active Time (a) could be measured with good inter-rater reliability; (b) would correlate highly with actigraphy counts, demonstrating concurrent validity; and (c) would be higher during high-intensity therapy sessions than standard of care sessions, demonstrating good discriminative validity. (Streiner & Norman 2008) Such results would demonstrate that it is feasible to measure Patient Active Time as an alternative to the measurement of intensity in the postacute rehabilitation setting.

METHODS

Participants

Twenty-six older adults who had been admitted to a SNF following discharge from an acute care hospital participated in this study. Potentially eligible participants were approached for recruitment by the study team immediately upon admission to the SNF. Written informed consent for participation in the study was obtained from each patient, in accordance with procedures approved by the university’s Institutional Review Board. The inclusion criteria were: 65 years of age or older and admitted to the SNF for postacute care PT and OT, with at least a two-week expected stay. The exclusion criteria were based on ability to participate in the study and included inability or unwillingness to provide informed consent; medical illness that would prevent study participation or accurate data collection (e.g., highly unstable cardiac illness such that early rehospitalization was expected); metastatic cancer or estimated survival was limited; and chart diagnosis of dementia or evidence of such on a cognitive screening.

As part of the research project, participants were randomized on a 1:1 basis to receive either Enhanced Medical Rehabilitation (called “high-intensity therapy” in this manuscript) or standard-of-care therapy throughout their SNF stay (Lenze et al., 2012). Briefly, those in the high-intensity group received therapy from therapists (1 PT, 1 OT, 1 PTA, 1 OTA) trained to provide more intense and more engaging medical rehabilitation. Specifically, they were trained and supervised to guide participants to more intensive activities and to not arbitrarily stop activities or exercises in favor of continuing them as long as the patient was able. Also, when a participant appeared to achieve a high intensity of therapy (based on self-ratings of exertion or heart rate changes), the therapists provided positive reinforcement as to the benefits of this intensity. The result of this training and supervision was that the therapists consistently used motivational principles in interacting with participants during all PT and OT sessions and consistently pushed for higher intensity therapy (Hildebrand et al., 2012). The high-intensity therapists were not told explicitly to aim for greater Patient Active Time.

MEASURES

Patient Active Time

Patient Active Time was defined as the total time when the participant can be observed actively engaging in a therapeutic activity or exercise during a treatment session. Time was recorded with a stopwatch by research staff either through direct observation or, for interrater reliability purposes, from a videotape held by a research assistant so as to always be focused on the therapist and participant. Time during each session is marked as either Active or Inactive. The times the participant was active during the session were summed and the total was the Patient Active Time for that session. This was expressed in total minutes per session. Examples of Active time include: (1) participant is moving to the edge of the bed, getting ready for a transfer, (2) participant is walking with the assistance of their physical therapist, (3) participant is practicing grooming activities at the bathroom sink with the assistance of their occupational therapist, (4) participant is performing isometric exercises, and (5) therapist is providing a uniform sustained stretch for neutralizing spasticity in wrist and hand. The main occurrences of Inactive time are: (1) participant is sitting and not doing any exercise because they are resting, (2) participant is sitting while the therapist is otherwise occupied (e.g., on the phone or with another patient), (3) therapy session is interrupted (e.g., by a physician coming by to see the participant), (4) therapist is engaged in discussion with the participant that does not involve the participant doing anything active, (5) therapist is preparing the therapy activity or goes to get something (e.g., equipment, drink of water) while the participant sits and waits, and (6) patient has completed an exercise (e.g., set of 10 leg lifts) and stops and waits for the therapist to recommend another exercise. Note that measurements of active versus inactive time do not attempt to make a determination as to the quality or appropriateness of particular therapeutic activities (e.g., education is generally Inactive time but is still important). Treating therapists were not made aware of Patient Active Time results or its measurement.

Three study team members (one PT, one OT, and one nontherapist) were raters for Patient Active Time which was assessed at one PT and one OT sessions per week, chosen at random, for each participant during their SNF stay. This sampling pattern allowed for a

representative sample of therapy sessions for each participant without undue burden created by constant observation. Almost all (>90%) of these Patient Active Time measures were done by direct observation, with the remainder being videotaped. For a subset of 10 sessions chosen at random across both high- and standard-intensity participants (5 PT and 5 OT), Patient Active Time was assessed by two independent raters (one directly observing, and one viewing it later on videotape) to examine the interrater reliability of the measure.

Accelerometry

To examine the concurrent validity of Patient Active Time, we simultaneously used accelerometry measurements. During the same sessions when Patient Active Time was recorded, participants wore four accelerometers (Gulf Coast Data Concepts, LLC, Waveland, MS, USA) (one on each wrist and each ankle). The accelerometers record counts of accelerations [1 count = magnitude of acceleration (>0) g for 0.025 s] in 3 dimensions at a frequency of 40 Hz. The accelerometers were attached via Velcro to adjustable wrist and ankle bands and were worn for the duration of the treatment session. These accelerometers have been tested and used in highly disabled stroke patients in previous research (Dobkin et al., 2011).

Of the 136 sessions for which Patient Active Time was measured, 92 sessions—47 PT sessions (24 high intensity and 23 standard intensity) and 45 OT sessions (25 high intensity and 20 standard intensity)—were assessed simultaneously by both observation of Patient Active Time and actigraphy. Accelerometry data were downloaded after each treatment session and analyzed with custom-written MATLAB software. The magnitude (square root of $x^2+y^2+z^2$) of the acceleration vector was calculated and subtracted (corrected) by 1 for gravity for each accelerometer. Then the area under the corrected acceleration curve, which is equal to the magnitude of movement velocity, was calculated. Signals from the four accelerometers were summed. Thus, the value for each person indicated the total change in velocity across all four limbs and was used as an index of the intensity of movement made by a patient during a therapy session.

Data Analysis—Systat version 13.0 was used to perform all of the statistical analyses; data were normally distributed. Pearson correlation coefficients were used to assess interrater reliability for Patient Active Time and to evaluate the strength of the relationship between Patient Active Time and accelerometry. Discriminative validity was examined by testing for group differences between the Enhanced Rehab group and the standard-of-care group with Student *t*-tests. Data are presented as means $\pm$ standard deviations, unless otherwise indicated.

RESULTS

This sample ($n = 26$) had a mean age of 77 years and 19/26 (74%) were female. Racial distribution was 12 (46%) Caucasian, 13 (50%) African-American, and 1 (4%) Asian. Participants had a variety of main underlying diagnoses, including hip fracture, cardiovascular diseases, stroke, and others; the major single reason for admission was deconditioning due to cardiopulmonary problems ($n = 14$, 54% of sample). They had multiple medical impairments with a mean cumulative illness rating scale (Miller et al.,

1992) score of 16, Short-Blessed Test (Davis et al., 1990) score mean = 4.7 (SD 3.9, range 0–11 indicating a range from no to mild impairment), and a mean initial Barthel Index score of 30 indicating severe disability (al-Khawaja et al., 1997). Most (16/26, 62%) were unable to walk without assistance at the time of admission. There were no significant differences between the high-intensity and standard-intensity groups except for number of medical impairments (greater in the high-intensity group).

Discriminative validity

In this sample, 136 sessions were measured for Patient Active Time: 67 PT (41 high intensity and 26 standard intensity) and 69 OT (46 high intensity and 23 standard intensity). Patient Active Time was significantly higher for therapy sessions in the participants randomized to high intensity, compared to those randomized to standard-intensity therapy: in PT sessions, Patient Active Time was 47.0 ± 13.5 min per high-intensity session versus 16.7 ± 10.1 min per standard-intensity session [t (df 65) = 9.8, $p < 0.001$]; In OT, 46.2 ± 15.2 min per high-intensity session versus 22.7 ± 6.6 min per standard-intensity session [t (df 67) = 7.0, $p < 0.001$]. These differences mirrored the actigraphy data: the total area under the acceleration curve was approximately doubled in the high-intensity group compared to the standard-intensity group for both PT and OT [PT actigraphy counts = $6.04 \times 10^4 \pm 1.14 \times 10^4$ per session in 23 high-intensity session versus $3.07 \times 10^4 \pm 0.80 \times 10^4$ per session in 24 standard-intensity session, t (df 45) = 9.6, $p < 0.001$; OT actigraphy counts = $4.54 \times 10^4 \pm 1.29 \times 10^4$ per session in 25 high-intensity session versus $2.25 \times 10^4 \pm 0.77 \times 10^4$ per session in 20 standard-intensity session, t (df 43) = 7.4, $p < 0.001$]. In other words, Patient Active Time and actigraphy data gave similar results in discriminating high-intensity from standard-intensity therapy sessions.

Of note, the high-intensity sessions were also of longer total duration than the standard-intensity sessions: PT high-intensity sessions lasted a total of 76.2 ± 12.0 min versus standard-intensity of 34.2 ± 14.7 min, OT high-intensity sessions lasted a total of 78.7 ± 16.2 min versus standard-intensity of 46.5 ± 8.1 min ($p < 0.001$ for both). For both PT and OT, the proportion of Patient Active Time to total session time was greater in the high-intensity therapy sessions than the standard-intensity: for PT 61% versus 47%; for OT 58% versus 49%.

Interrater reliability

The intraclass correlation coefficient (ICC) between two independent raters for Patient Active Time was 0.995 ($p < 0.001$) for five PT sessions and 0.95 ($p = 0.012$) for five OT sessions, indicating excellent interrater reliability.

Concurrent validity

The correlation between Patient Active Time and accelerometry counts was $r = 0.73$ ($p < 0.001$) for the PT sessions and $r = 0.60$ ($p < 0.001$) for the OT sessions (See Figure 1), indicating moderate to good concurrent or convergent validity (Kraemer, 2013).

DISCUSSION

We developed Patient Active Time as an objective measure that can be used to characterize the intensity of PT and OT sessions. It has good interrater reliability and moderate to good concurrent (convergent) validity as demonstrated by the high correlation with actigraphy. This observation builds on similar work which found high concurrent validity (ICC 0.79–0.93) between active time and accelerometer data in five participants during PT treatment sessions (Choquette et al., 2008). We found a higher correlation of Patient Active Time with accelerometry counts in PT than OT sessions; this may be due to the more exercise-based nature of PT in postacute rehabilitation. Patient Active Time scores also discriminated between Enhanced Medical Rehabilitation (the experimental therapy format designed to have high therapy intensity) and standard-intensity PT or OT, demonstrating discriminative validity.

We conclude that Patient Active Time may be a useful measure of therapy intensity, particularly in settings in which a physiologic measure of intensity would be difficult to carry out or interpret. It also has the advantage of requiring no equipment. Patient Active Time can be assessed by a trained rater either using direct observation or via videotape. Our experience with videotaped sessions was that they were no more difficult for raters or therapists than was by direct observation. For studies that plan to use Patient Active Time to measure therapy intensity, we recommend initially that raters watch sessions together or watch videotaped sessions in order to calibrate against each other. Videotaped sessions can also be kept for rater-training purposes and measuring interrater reliability which ought to be done with any study's observation-based measures.

What is ultimately needed is predictive validity, not just of this new measure of Patient Active Time, but of the ability of differences of therapy intensity to produce differential outcomes in postacute rehabilitation. For future research about the efficacy of various rehabilitation interventions, we suggest that measurement of Patient Active Time could provide a different perspective regarding intensity than accelerometry; for example, therapy done on highly debilitated individuals or using modalities such as standing balance or maintenance stretch would likely be assessed as low-intensity via accelerometry counts but not by Patient Active Time. Such measurement would be helpful for research studies of rehabilitative interventions to show, for example, that an intervention designed to increase the intensity of therapy actually is doing so. Measuring Patient Active Time may also be important for research evaluating the optimal levels of active time for different patient groups and levels of care. Caution is needed, however, in interpreting Patient Active Time as intensity, as the two constructs have differences. For example, in some severely disabled patients, even sitting up comfortably may induce a level of exercise intensity. Also, this study has limited generalizability, as it was carried out at a single facility; further studies are needed to further demonstrate the generalizability and utility of this new measure. Patient Active Time could have utility as a clinical tool (e.g., in training or supervising therapists to reduce down time in therapy) but first it would be important to know if this would provide better patient outcomes and could be implemented across SNFs as has been shown with other gold-standard measures (Shah et al., 2012). However, caution is needed with respect to using Patient Active Time—or any intensity measure—for purposes such as quality

assurance or reimbursement, as doing so could have the unintended consequence of therapists forgoing some important but nonactive parts of therapy such as providing education. In summary, Patient Active Time is a valid and reliable objective measure of PT and OT session activity that could be a useful alternative to the measurement of therapy intensity in the postacute rehabilitation setting.

Acknowledgments

The authors would like to thank Carolyn Carrabine, Linsey Kraus Smith, Marijon Stern, Cindy Messinger, Cathy Huels, Jacqueline Bitticks, Leah Wendleton, Peter Doré, and Brian Carpenter.

Abbreviations

PT	Physical Therapy
OT	Occupational Therapy
SNF	Skilled Nursing Facility

REFERENCES

- al-Khawaja I, Wade DT, Turner F. The Barthel Index and its relationship to nursing dependency in rehabilitation. *Clinical Rehabilitation*. 1997; 11:335–337. [PubMed: 9408675]
- Bohannon RW. Time use by inpatients receiving neurorehabilitation. *Perceptual and Motor Skills*. 2003; 97:68–70. [PubMed: 14604023]
- Chan L. The state-of-the-science: challenges in designing postacute care payment policy. *Archives of Physical Medicine and Rehabilitation*. 2007; 88:1522–1525. [PubMed: 17964899]
- Choquette S, Hamel M, Boissy P. Accelerometer-based wireless body area network to estimate intensity of therapy in post-acute rehabilitation. *Journal of Neuroengineering and Rehabilitation*. 2008; 5:20. [PubMed: 18764954]
- Davis PB, Morris JC, Grant E. Brief screening tests versus clinical staging in senile dementia of the Alzheimer type. *Journal of the American Geriatrics Society*. 1990; 38:129–135. [PubMed: 2299116]
- Dobkin BH, Xu X, Batalin M, Thomas S, Kaiser W. Reliability and validity of bilateral ankle accelerometer algorithms for activity recognition and walking speed after stroke. *Stroke*. 2011; 42:2246–2250. [PubMed: 21636815]
- Gordon NF, Gulanick M, Costa F, Fletcher G, Franklin BA, Roth EJ, et al. Physical activity and exercise recommendations for stroke survivors: an American Heart Association scientific statement from the Council on Clinical Cardiology, Subcommittee on Exercise, Cardiac Rehabilitation, and Prevention; the Council on Cardiovascular Nursing; the Council on Nutrition, Physical Activity, and Metabolism; and the Stroke Council. *Circulation*. 2004; 109:2031–2041. [PubMed: 15117863]
- Hildebrand MW, Host HH, Binder EF, Carpenter B, Freedland KE, Morrow-Howell N, et al. Measuring treatment fidelity in a Rehabilitation Intervention Study. *American Journal of Physical Medicine & Rehabilitation*. 2012; 91:715–724. [PubMed: 22377824]
- Idland G, Smastuen MC, Engedal K, Bergland A. Functioning and self-rated health in the oldest old community-dwelling women: a four-year longitudinal study. *Physical & Occupational Therapy in Geriatrics*. in press.
- Jette DU, Warren RL, Wirtalla C. The relation between therapy intensity and outcomes of rehabilitation in skilled nursing facilities. *Archives of Physical Medicine and Rehabilitation*. 2005; 86:373–379. [PubMed: 15759214]
- Joo KC, Brubaker PH, MacDougall A, Saikin AM, Ross JH, Whaley MH. Exercise prescription using resting heart rate plus 20 or perceived exertion in cardiac rehabilitation. *Journal of Cardiopulmonary Rehabilitation*. 2004; 24:178–184. quiz 185–176. [PubMed: 15235299]

- Kimberley TJ, Samargia S, Moore LG, Shakya JK, Lang CE. Comparison of amounts and types of practice during rehabilitation for traumatic brain injury and stroke. *Journal of Rehabilitation Research & Development*. 2010; 47:851–862. [PubMed: 21174250]
- Kluwer, W. ACSM's guidelines for exercise testing and prescription. 8th Edition. Lippincott Williams & Wilkins; Baltimore, MD: 2010.
- Kraemer HC. Toward sound objective evaluation of clinical measures. *The American Journal of Geriatric Psychiatry*. 2013; 21:589–595. [PubMed: 23764524]
- Kwakkel G, Wagenaar RC, Twisk JW, Lankhorst GJ, Koetsier JC. Intensity of leg and arm training after primary middle-cerebral-artery stroke: a randomised trial. *Lancet*. 1999; 354:191–196. [PubMed: 10421300]
- Lang CE, MacDonald JR, Gnip C. Counting repetitions: an observational study of outpatient therapy for people with hemiparesis post-stroke. *Journal of Neurologic Physical Therapy*. 2007; 31:3–10. [PubMed: 17419883]
- Lang CE, Macdonald JR, Reisman DS, Boyd L, Jacobson Kimberley T, Schindler-Ivens SM, et al. Observation of amounts of movement practice provided during stroke rehabilitation. *Archives of Physical Medicine and Rehabilitation*. 2009; 90:1692–1698. [PubMed: 19801058]
- Lenze EJ, Host HH, Hildebrand M, Morrow-Howell N, Carpenter B, Freedland KE, et al. Enhanced medical rehabilitation is feasible in a skilled nursing facility: preliminary data on a novel treatment for older adults with depression. *The American Journal of Geriatric Psychiatry*. 2013; 21:307. [PubMed: 23395198]
- Lenze EJ, Host HH, Hildebrand MW, Morrow-Howell N, Carpenter B, Freedland KE, et al. Enhanced medical rehabilitation increases therapy intensity and engagement and improves functional outcomes in postacute rehabilitation of older adults: a randomized-controlled trial. *Journal of the American Medical Directors Association*. 2012; 13:708–712. [PubMed: 22863663]
- MacKay-Lyons MJ, Makrides L. Cardiovascular stress during a contemporary stroke rehabilitation program: is the intensity adequate to induce a training effect? *Archives of Physical Medicine and Rehabilitation*. 2002; 83:1378–1383. [PubMed: 12370872]
- Miller MD, Paradis CF, Houck PR, Mazumdar S, Stack JA, Rifai AH, et al. Rating chronic medical illness burden in geropsychiatric practice and research: application of the Cumulative Illness Rating Scale. *Psychiatry Research*. 1992; 41:237–248. [PubMed: 1594710]
- Munin MC, Putman K, Hsieh CH, Smout RJ, Tian W, DeJong G, et al. Analysis of rehabilitation activities within skilled nursing and inpatient rehabilitation facilities after hip replacement for acute hip fracture. *American Journal of Physical Medicine and Rehabilitation*. 2010; 89:530–540. [PubMed: 20567135]
- Munin MC, Seligman K, Dew MA, Quear T, Skidmore ER, Gruen G, et al. Effect of rehabilitation site on functional recovery after hip fracture. *Archives of Physical Medicine and Rehabilitation*. 2005; 86:367–372. [PubMed: 15759213]
- Outermans JC, van Peppen RP, Wittink H, Takken T, Kwakkel G. Effects of a high-intensity task-oriented training on gait performance early after stroke: a pilot study. *Clinical Rehabilitation*. 2010; 24:979–987. [PubMed: 20719820]
- Shah S, Tartaro C, Chew F, Morris M, Wood C, Wuzzardo A. Rehabilitation Efficiency and Effectiveness in Medical-Surgical Conditions: A Pilot Study of 234 Patients. *Physical & Occupational Therapy in Geriatrics*. 2012; 30:288–300.
- Singh NA, Quine S, Clemson LM, Williams EJ, Williamson DA, Stavrinou TM, et al. Effects of high-intensity progressive resistance training and targeted multidisciplinary treatment of frailty on mortality and nursing home admissions after hip fracture: a randomized controlled trial. *Journal of the American Medical Directors Association*. 2012; 13:24–30. [PubMed: 21944168]
- Streiner, DL.; Norman, GR. Health measurement scales: a practical guide to their development and use. Streiner, DL.; Norman, GR., editors. Oxford University Press; Validity: 2008. p. 247-276.
- Talkowski JB, Lenze EJ, Munin MC, Harrison C, Brach JS. Patient participation and physical activity during rehabilitation and future functional outcomes in patients after hip fracture. *Archives of Physical Medicine and Rehabilitation*. 2009; 90:618–622. [PubMed: 19345777]

Figure 1.
Correlation between actigraphy counts and Patient Active Time minutes for PT (a) and OT (b) sessions.