

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: **Hayes, Heather A.**

eRA COMMONS USER NAME: HEATHERHAYES

POSITION TITLE: Assistant Clinical Professor, Department of Physical Therapy and Athletic Training, College of Health, University of Utah

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.*)

INSTITUTION AND LOCATION	DEGREE	MM/YYYY	FIELD OF STUDY
Tulane University, New Orleans, LA	BA	05/1990	International Relations
Northern Arizona University, Flagstaff, AZ	DPT	05/2003	Physical Therapy
University of Utah, Salt Lake City, UT	PhD	05/2014	Exercise and Sports Science

A. Personal Statement

I was hired in 2004 as a Clinical Instructor within the Department of Physical Therapy and Athletic Training (PT/AT) at the University of Utah (UU) because of my unique perspective on stroke rehabilitation. I was able to create 2 unique programs for individuals with stroke; 1) a wellness/exercise program, and 2) an intensive goal-oriented program. Both of these programs have received national and international attention from clinicians and individuals post-stroke. When I started within the Department of PT/AT I did not foresee myself seeking a long-term career as an independent rehabilitation science investigator in rehabilitation health services. Yet, over time, I realized that to better improve the care of my patients I needed to expand my knowledge base beyond clinical application. With the full support from my department, I pursued and then received my PhD in Exercise and Sports Science. In 2014, I was promoted to Assistant Clinical Professor with joint appointments in the Department of PT/AT and the Division of Physical Medicine and Rehabilitation (PM&R). Both the Department and Division were supportive of me pursuing my research career in stroke rehabilitation. They nominated me for the Vice President's Clinical and Translation (VPCAT) Research Scholars Program at the UU to ensure further advancement of my research career. Through this program, I have expanded my research goals and I am now seeking a K01 Career Development Award to facilitate my transition to an independent rehabilitation science, health services investigator. The focus of my current research examines how the organization of the health care system impacts patient outcomes after stroke. Specifically, I am examining the client and non-client variables associated with discharge to an inpatient rehabilitation facility (IRF) or a skilled nursing facility (SNF) and the short-term (post facility placement) and long-term impact (6-months post-stroke) on function. This research will have a strong clinical impact by informing clinicians in the acute care setting about discharge placement and which rehabilitation service will lead to optimal individual outcomes after stroke.

In addition to the Research Aims, I am proposing Career Development Aims that will provide me with the necessary training, mentorship, and practical experience to become an independent investigator. I have practiced as a physical therapist focused on stroke rehabilitation for over 14 years. I have expert knowledge of the recovery challenges that individuals' post-stroke experience across the continuum of care and lifespan. My clinical and professional background has focused on improving rehabilitation for individuals post-stroke at local (Utah Stroke Task Force), regional (Western States Stroke Task Force, American Heart/Stroke Association), and national (Chair, Stroke Special Interest Group, Academy of Neurologic Physical Therapy) level. My PhD work provided me with a sound understanding of research design and analysis. My participation in the VPCAT Program has allowed me to expand my research, professional, and leadership skills.

Since my original K01 submission, I have taken the initiative to further establish foundational knowledge enhancing my ability to quickly start and effectively manage the proposed K01 upon award. With guidance from my mentoring team, I completed a UU *Introduction to Biostatistics* course and a US Department of Veterans Affairs *Cost-Effectiveness Analysis* course. I have completed both the University of Utah's *Leadership I: Foundations in Leadership* and *Leadership II: Applied Techniques* seminars and received my *Clinical Research Certificate (CRC)* through the University's Research Administration Series. In late 2018, I was accepted as a member of the Health Services Research Networking Group and the Stroke Interdisciplinary Special Interest Group of the American Congress Rehabilitation Medicine, both of which are in direct alignment with my career aim. In addition, I have had 3 peer-reviewed publications [1-3] released since my original submission, two of which I first authored [1-2]. Moreover, I continue to work towards my research goals. In strong collaboration with my mentors and advisor, I have gained additional preliminary data that further strengthens my proposed research aims presented in this proposal. This data was submitted and accepted for presentation as an abstract at the Workshop for Implementing AM-PAC and Other Tools to Demonstrate Value [4]. The forthcoming manuscript,

which includes members from my mentoring team, is in its final phases with a firm submission deadline of December 2018. This work, which I am near completing, is a retrospective analysis on 2,800 individuals post-stroke to determine the predictive ability of the Activity Measure for Post-Acute Care (**AM-PAC**) Inpatient “6-Clicks” Tool to discharge to home versus a facility (IRF or SNF) and discharge to an IRF versus a SNF. Based on the above work, I was accepted to attend the Center on Health Services Training and Research (**CoHSTAR**) Health Services Research Intensive Workshop in 2018. This research is directly aligned to my long-term research career goal to independently investigate optimizing stroke rehabilitation care. Ultimately, my determination and will to advance my career goals combined with my expanding clinical, professional, didactic, and research knowledge makes me an ideal candidate to promote change in stroke rehabilitation. **However, I need additional, focused training and mentorship to become an independent investigator in rehabilitation health services research.** My K01 award focused on health services, comparative effectiveness, outcomes research, and cost-effective analyses will provide me with the necessary knowledge and expertise to become a leader in stroke rehabilitation health services.

To further enhance my success, I have established a strong mentor team who will guide my research and career development goals. My Primary Mentor, Rachel Hess, MD, MS from the Division of Health System and Innovation Research (**HSIR**) at the UU, has extensive mentoring experience and is an expert in health services research. My Co-Mentors will provide assistance in their areas of expertise: Lorie G. Richards PhD, PTR/L, FAHA, has an extensive background in stroke rehabilitation research and health services research, Jacob Kean, PhD from the Division of HSIR has expertise in rehabilitation health services, comparative effectiveness, and outcomes research; and Elissa Ozanne, PhD has expertise in cost-effectiveness analysis. I have a strong advisor, Angela Presson, PhD to assist me with developing my skills in health services research statistical design, analysis, and interpretation. Finally, both the Department of PT/AT and the Division of PM&R fully support my career and research aims. The NICHD K01 award, will serve as a mechanism to speed my launch into an independent researcher in stroke rehabilitation health services able to improve care for stroke survivors.

1. **Hayes HA**, Dibella D, Crockett R, Dixon M, Butterfield RJ, Johnson NE. Stepping Activity in Children With Congenital Myotonic Dystrophy. *Pediatr Phys Ther.* 2018 Oct;30(4):335-339.
2. **Hayes HA**, George S, Dibble LE. Increased practice of a standing motor sequence task in healthy young and healthy elders: Short communication. *Gait Posture.* 2018 Jun;63:1-4.
3. Pucillo EM, McIntyre MM, Pautler M, Hung M, Bounsanga J, Voss MW, **Hayes H**, Dibella DL, Trujillo C, Dixon M, Butterfield RJ, Johnson NE. Modified dynamic gait index and limits of stability in myotonic dystrophy type 1. *Muscle Nerve.* 2018 Aug 30. [Epub ahead of print]
4. **Hayes HA**, McFadden M, Richards L, Marcus R, Kean J, Davis A, Edgley S, Hess R. Activity Measure for Post-Acute Care Inpatient “6-Clicks” as a discharge for Individuals post-acute stroke [Abstract]. *Workshop for Implementing AM-PAC & Other Tools to Demonstrate Value*; Feb, 2018; Salt Lake City, UT.

B. Positions and Honors

Employment

2004-present Physical Therapist, Balance & Mobility Clinic (formerly Rehabilitation & Wellness Clinic), Department of PT/AT, College of Health (**COH**), UU, Salt Lake City, UT
2004-2014 Clinical Instructor, Department of PT/AT, COH, UU, Salt Lake City, UT
2009-present Director, Utah Neurologic Physical Therapy Residency Program, Department of PT/AT, COH, UU Salt Lake City, UT
2014-present Assistant Clinical Professor, Department of PT/AT, COH, UU, Salt Lake City, UT
2015-present Assistant Clinical Professor, Division of PM&R, UU, Salt Lake City, UT

Other Experience and Professional Memberships

1999-present Certified, Neurologic Clinical Specialist, American Board of Physical Therapy Specialties
2000-present Member, American Physical Therapy Association (**APTA**)
2003-present Member, Academy of Neurologic Physical Therapy (**ANPT**)
2003-present Member, Stroke Specialist Interest Group, ANPT
2006-2012 President, Rehabilitation Committee, Utah Stroke Task Force
2013-2015 Member, Stroke Task Force, Western States Affiliate, American Heart/Stroke Association,
2017-present Chair, Stroke Specialist Interest Group, ANPT
2018-present Member, Health Services Research Networking Group, American Congress Rehabilitation Medicine (**ACRM**)
2018-present Member, Stroke Interdisciplinary Special Interest Group, ACRM

Honors

2011	Recipient, <i>Golden Synapse Award</i> (Outstanding Paper of the Year), <i>J Neurol Phys Ther</i>
2014	Recipient, Beacons of Excellence Award for the Rehabilitation and Wellness Clinic, UU
2017-2018	Scholar, Vice President's Clinical and Translational (VPCAT) Research Scholars Program, Office Academic Affairs and Faculty Development, UU, Salt Lake City, UT
2018	Recipient, Health Services Research Intensive Workshop Travel Award, CoHSTAR
2018	Recipient, <i>Best Research Project Award</i> , UT Physical Therapy Association (UTPTA) Meeting, Fall Conference

C. Contribution to Science (Note that when I am primary writer, I am first author. When I publish with my trainees or on projects that I initiated and obtained funding for, I am listed as the last / senior author.)

- 1. Physical Therapy in Neurologic Disease:** I have dedicated my clinical practice to improving the mobility and health of individuals with neurologic disease. As a clinician-scientist, I have contributed to furthering our scientific knowledge associated with functional mobility of individuals with neurologic diseases by working as a key member of strong research collaborations. Through these collaborations, I gained experience in the organization and implementation of randomized controlled trials, research design of cross-sectional studies, and expanded my network. Prior to my PhD, I led the research trial, performed the analysis and prepared the publication, disseminating the results from the National Multiple Sclerosis Society - Utah Chapter pilot award, *High Force, Low-cost Resistance Training for Individuals with Multiple Sclerosis* (PI: LaStayo). The paper received the "Golden Synapse Award" for the outstanding JNPT article of 2011 [a]. Our work has been cited regularly through key journals in the fields of both physical medicine and rehabilitation and neurology. In 2015, I began working with a research team led by Dr. Nicholas Johnson studying congenital myotonic dystrophy and in the following year, I contributed to the design and analysis of the peer-reviewed manuscripts disseminating our findings [b, c]. With my appointment within the Division of PM&R, I have collaborated with the inpatient rehabilitation therapists leading studies for improving the quality of care in individuals post-stroke. One project received an award as *Best Research Project* at the UTPTA Fall meeting [d].
 - a. Hayes HA, Gappmaier E, LaStayo PC.** Effects of high-intensity resistance training on strength, mobility, balance, and fatigue in individuals with multiple sclerosis: a randomized controlled trial. *J Neurol Phys Ther.* 2011 Mar;35(1):2-10. **(As of October 2018, cited 42 times per Scopus)**
 - b. Johnson NE, Butterfield R, Berggren K, Hung M, Chen W, DiBella D, Dixon M, Hayes H, Pucillo E, Bounsanga J, Heatwole C, Campbell C.** Disease burden and functional outcomes in congenital myotonic dystrophy: A cross-sectional study. *Neurology.* 2016 Jul 12;87(2):160-167. [PMCID: PMC4940062](#) **(As of October 2018, cited 6 times per Scopus)**
 - c. Pucillo EM, McIntyre MM, Pautler M, Hung M, Bounsanga J, Voss MW, Hayes H, Dibella DL, Trujillo C, Dixon M, Butterfield RJ, Johnson NE.** Modified dynamic gait index and limits of stability in myotonic dystrophy type 1. *Muscle Nerve.* 2018 Aug 30. [Epub ahead of print]
 - d. Wells S, Hayes HA.** Characteristics of fallers and non-fallers after an inpatient rehab facility stay. [Abstract]. *Utah Physical Therapy Association Fall Conference*; Nov, 2018; Salt Lake City, UT.
- 2. Technology in Physical Therapy:** There is a great importance to develop and enhance technology that will aid movement in patients with neurologic diseases. I have collaborated with colleagues at UU to identify novel technologies/devices to aid patients with neurologic disease. I contributed to the study design and analysis of a tool for engaging individuals post-stroke with an upper limb rehabilitation system using Kinect™ [a]. Our results have made an impact in the scientific community including within the fields of computer engineering and robotics. I also contributed to the study design and analysis of a gait measuring device [b]. This area of my career has expanded my understanding of research design and methodologies. I am lead author on a manuscript submitted to *Pediatr Phys Ther* reporting our findings of stepping activity in children with congenital myotonic dystrophy [c]. This article highlights an important concept that had not been assessed before, namely, physical activity in children with neuromuscular disease. This article received a commentary response because of its importance to pediatric physical therapy practice [d].
 - a. Pastor I, Hayes HA, Bamberg SJ.** A feasibility study of an upper limb rehabilitation system using Kinect and computer games. *Conf Proc IEEE Eng Med Biol Soc.* 2012;2012:1286-1289. **(As of October 2018, cited 36 times per Scopus)**

- b. Howell AM, Kobayashi T, **Hayes HA**, Foreman KB, Bamberg SJ. Kinetic Gait Analysis Using a Low-Cost Insole. *IEEE Trans Biomed Eng.* 2013 Dec;60(12):3284-3290. **(As of October 2018, cited 47 times per Scopus)**
- c. **Hayes HA**, Dibella D, Crockett R, Dixon M, Butterfield RJ, Johnson NE. Stepping Activity in Children With Congenital Myotonic Dystrophy. *Pediatr Phys Ther.* 2018 Oct;30(4):335-339.
- d. Kiefer MJ, Townsend EL. Commentary on “Stepping Activity in Children With Congenital Myotonic Dystrophy”. *Pediatr Phys Ther.* 2018 Oct;30(4):340.
3. **Learning in Neurologic Disease:** My clinical practice has focused on improving the function of individuals with neurological disorders, focusing on the concepts of neuroplasticity and motor learning. Desiring to add more evidence to the research led me to pursue my PhD. My PhD work focused on the influence that learning has on neurologic rehabilitation. At the start of the PhD, I completed a Meta-Analysis **[a]** to synthesize the data available about motor sequence learning for individuals with Parkinson disease. At the completion of my dissertation, I published the larger results of my clinical research, which assessed the influence of dopamine on sequence learning during a postural task in individuals with Parkinson disease **[b]**. After my PhD work, I expanded the learning paradigm to determine if more practice would improve the performance of healthy elders to match the performance of healthy young **[c]**.
- a. **Hayes HA**, Hunsaker N, Dibble LE. Implicit Motor Sequence Learning in Individuals with Parkinson Disease: A Meta-Analysis. *J Parkinsons Dis.* 2015;5(3):549-560. **(As of October 2018, cited 5 times per Scopus)**
- b. **Hayes HA**, Hunsaker N, Schaefer SY, Shultz B, Schenkenberg T, Boyd LA, White AT, Foreman KB, Dyer P, Maletsky R, Dibble LE. Does Dopamine Replacement Medication Affect Postural Sequence Learning in Parkinson’s Disease? *Motor Control.* 2015 Oct;19(4):325-340. **(As of October 2018, cited 7 times per Scopus)**
- c. **Hayes HA**, George S, Dibble LE. Increased practice of a standing motor sequence task in healthy young and healthy elders: Short communication. *Gait Posture.* 2018 Jun;63:1-4.
4. **Clinical Perspectives in Neurologic Rehabilitation:** Throughout my clinical career, I have advocated for patients and clinicians. I regularly engage in American Physical Therapy Association (**APTA**) events and I have participated in multiple leadership roles in the Academy of Neurologic Physical Therapy (**ANPT**). I have served on the Practice Committee in ANPT and contributed my expertise to a publication on autonomous practice in neurologic physical therapy **[a]**. Currently, I serve as Chair of the ANPT Stroke Special Interest Group. I have taken the initiative in my own Department by proposing, developing, and establishing the Utah Neurologic Physical Therapy Residency Program. What was once 1 of 18 programs in 2011, I now direct one of 34 programs across the US. As the director, I provide expert knowledge to physical therapist residents and mentors about neurologic physical therapy across the continuum of care. Further, I direct a 2-week intensive program for stroke survivors focusing on goal-specific practice. It is designed to train clinicians about practice paradigms focused on neuroplasticity and motor learning concepts. I developed a “wellness” program for individuals post-stroke and this unique perspective allowed me to provide my expertise on wellness and physical activity in the *J Neurol Phys Ther* **[b]**. I am involved with the ANPT participating in many national/international events, including facilitating educational work group at the *IV Step Conference (2016), Prevention, Prediction, Plasticity, and Participation* linking evidence into practice **[c]**.
- a. Cormack J, Gobert D, Hardage J, **Hayes H**, Malonzo C, Parlman K, Zipp GP. Perspective from the practice committee: is autonomous practice in neurologic physical therapy defined differently based on the type of practice setting? *J Neurol Phys Ther.* 2010 Sep;34(3):175-176.
- b. Addison O, Whetten B, **Hayes H**, DeJong SL. Reviews of wellness and physical activity web sites for persons with neurological disability. *J Neurol Phys Ther.* 2013 Jun;37(2):91-93.
- c. Kloos A, Carey H, Fernandez J, McCarthy A, Le Cras S, Moore J, Miles C, McCain K, Stoeckmann T, Snowdon L, **Hayes H**, Ellis T, Kobal K [Facilitators]. Video-based Case Presentations and Discussion Exploring Adult (TBI, CVA, SCI, MS, PD, CNS Neoplasms) and Pediatric (CP, TBI, DS, MD, DCD). Facilitated at: *IV STEP Conference Proceedings 2016: Prevention, Prediction, Plasticity, and Participation*; July, 2017; Alexandria, VA.

Complete List of Published Work in MyBibliography

<https://www.ncbi.nlm.nih.gov/sites/myncbi/16oshW6gRLRA7/bibliography/43384654/public/?sort=date&direction=ascending>

D. Research Support

Ongoing Research Support

5R01NR015591-03 (Subaward) Holman/Cramer (MPI) 08/01/2017-03/31/2019
University of California - Irvine / NIH/NINR
Genetic Variation, Stress, and Functional Outcomes after Stroke Rehabilitation
Goals: Examine how genetic polymorphisms interact with rehabilitation therapy and stress to affect treatment-induced recovery after stroke.
Role: Co-Investigator / Site Lead

STMR Pain 002 PSSP (NCT03093935) Hayes (PI) 07/01/2017-11/30/2019
Bioness, Inc.
StimRouter™ Neuromodulation System: Implanted Peripheral Nerve Stimulation for Pain Management when Treating Patients with Chronic Post-stroke Shoulder-pain
Goals: Study Design is prospective, multi-center and will include approximately 50 adults with severe intractable chronic shoulder pain subsequent to stroke. They will participate in the study through 6 months of follow-up. StimRouter™ Neuromodulation System includes an implanted lead which provides peripheral nerve stimulation for chronic pain. Various measures will be used to assess patient response to use of the device.
Role: Principal Investigator

Pilot Grant Hayes (PI) 08/01/2016-12/31/2018
Center on Aging / University of Utah
Psychological, Physical, and Social Influences on Elder Caregivers of Stroke
Goals: Determine the changing emotional needs and physical activity levels of elder caregivers after they have completed formal rehabilitation services.
Role: Principal Investigator

Completed Research Support

10046564 (Subaward) Kegelmeyer (PI) 07/01/2017-12/18/2017
The Ohio State University / Honda Research Institute USA, Inc.
National Descriptive Study of the Home Health Physical Therapy (PT) Environment
Goals: A multi-center trial captured data on the home health PT environment including challenges faced by individuals who are undergoing PT to improve their ability to walk after a neurologic condition.
Role: Co-Investigator / Site Lead

Research Instrumentation Award Hayes (PI) 05/01/2015-05/01/2015
VP for Research / University of Utah
Quantitative Assessment of Gait Spatiotemporal Changes in Individuals with Chronic Disability
Goals: To purchase of a GaitRite® System for the Department of Physical Therapy for multidisciplinary research.
Role: Principal Investigator

Pilot Award Hayes (PI) 05/01/2007-12/31/2011
Center for Contemporary Rehabilitation, Research, Education, and Practice / University of Utah
Determining Improvements of Functional Ambulation: Gait Speed, Quality and Community Ambulation for Individuals with Chronic Stroke by Providing Two Intensive Training Programs
Goals: Assessed which type of training would bring greater functional changes in individuals with chronic stroke.
Role: Principal Investigator

2410069 LaStayo (PI) 11/01/2005-10/31/2009
National Multiple Sclerosis Society - Utah Chapter
High Force, Low-cost Resistance Training for Individuals with Multiple Sclerosis (MS)
Goals: Assessed which type of intervention (high-force, low cost vs standard of care) would improve functional change for individuals with MS.
Role: Co-Investigator

Pilot Award Dibble (PI) 05/01/2005-12/31/2007
Primary Care Research Center / University of Utah
Exercise Training in Stroke Survivors: Secondary Prevention of Recurrent Strokes and Fall Related Injuries
Goals: Assessed the influence that regular exercise training had on recurrent strokes and fall related injuries.
Role: Co-Investigator