Department of Physical Therapy, Movement and Rehabilitation Sciences

Annual Research Report 2015
for calendar year 2014
**Mission**
The Department of Physical Therapy, Movement and Rehabilitation Sciences' research mission is to build the evidence for best practices to maintain and improve the health and wellbeing of the local, national, and global community members.

**Contents**

Mission .............................................................................................................................................................. 2

Highlights from 2014....................................................................................................................................... 3

Description of research program .................................................................................................................. 3

Description of Laboratories............................................................................................................................ 4

  Occupational Biomechanics and Ergonomics Laboratory (Jack Dennerlein) .............................................. 4
  Center for Cancer Survivorship Studies (Ann Marie Flores) ................................................................. 4
  Neuromotor Systems Laboratory (C.J. Hasson) ......................................................................................... 4

Teaching and Learning Innovation Program (Lorna Hayward) ............................................................... 5

Rehabilitation and Epidemiology Trainee Program (Maura D. Iversen) ................................................. 5

Neurophysiology Laboratory (Robert Sikes) ............................................................................................ 5

Laboratory for Locomotion Research (Sheng-Che Yan) ......................................................................... 6

Peer reviewed journal articles in 2014 ......................................................................................................... 7

Conference Abstracts and Presentations .................................................................................................... 9

  National and International conference presentation ......................................................................... 9

  Local conferences and presentations ................................................................................................. 14

Grants Submitted ($2.35 million) .............................................................................................................. 17

Funded Grants ............................................................................................................................................... 18
Highlights from 2014

The Department of Physical Therapy, Movement, and Rehabilitation Sciences had an excellent year with regard to research in 2014. The department continued to grow with new faculty recruiting efforts with three new faculty to be hired in 2015. Researchers were very productive publishing their work and submitting new grants applications to expand our current activities in upcoming years. Highlights from the 2014 calendar year include

- Over 30 peer reviewed journal publications
- Over 95 presentations at local, national, and international conferences
- Over 41 citations of works by tenure-track faculty with an average H-index of 10
- $2.35 million in direct costs for multi-year grants submitted to external agencies
- $1.08 million in direct costs for research grant activity in 2014

Description of research program

At the heart of the research is the success of the department’s faculty and their resources. The department has over 5,000 square feet of research laboratories mostly located within Robinson and Richards Hall equipped with the state of the art research equipment. Equipment include systems to measure human motion, posture and force, neurophysiology, muscle and tissue physiology, and musculoskeletal structure and include intervention systems such as rehabilitation robots and office ergonomic furniture. Other capabilities include survey and population data base resources and software.

A Department strength is its local and global research partners. Within Northeastern the Department has strong partners with the Health Sciences Department in Bouvé College of Health Science along with research partners in the College of Engineering, College of Science, the College of Arts, Media & Design, and the College of Social Sciences and Humanities. Within Boston the faculty collaborate with centers at neighboring institutions such as Harvard Medical School, Harvard School of Public Health, Dana Farber Cancer Institute, Tufts Medical Center, Boston University, Massachusetts General Hospital, Boston Children’s Hospital, Brigham and Women’s Hospital, and the Liberty Mutual Research Institute for Safety. In terms of national and global partners, the Department’s faculty have strong ties with the University of Massachusetts Amherst, New York University, SUNY Upstate Medical School, University of Washington, Vanderbilt, University of Southern Denmark, Karolinska Institutet, Maastricht University and VU University in Amsterdam.

In addition, the department has many partnerships with industry. Our industrial partners span different business sectors such as entertainment, service and retail, transportation, warehousing, health care, pharmaceutical, and computer industries. Our faculty work with Boston Dynamics (Robotic), Local Construction Companies (Gilbane, Suffolk, Shawmut, Skanska, and JMA), Mylan Limited, Pzifer (Pharmaceutical), Cerrejón (Coal mining), the Office Ergonomics Research Committee (www.oerc.org), Bose, Schneider, Partners Health Care, and Partners in Health (health coaching and wellness company).
Description of Laboratories

Occupational Biomechanics and Ergonomics Laboratory (Jack Dennerlein)
001 Robinson Hall 1190 square feet
The Occupational Biomechanics and Ergonomics Laboratory research aims to prevent work-related musculoskeletal disorders by understanding injury mechanisms through laboratory and field studies that utilize biomechanics, neuromuscular, exposure-response, and intervention study designs and methods. Located on the ground floor of Robinson Hall, this space contains a state of the art office space for research staff and trainees and a human movement and biomechanics laboratory space, both approximately 600 square feet. The flexible design of biomechanics laboratory space allows for a range of experiments investigating thumb movements while using mobile computing technology to the ergonomics of dynamic office workstation designs. The laboratory contains equipment to measure human motion and posture, surface electromyography, and applied forces. Human motion equipment includes Northern Digital Optotrak system and Ascension Technology Mini-Bird systems. Electromyography equipment include a 12 channel Delsys and an 8 channel wireless Mega systems. Load cells to measure force include custom made force plates for computing to ATI 3-axis force-torque sensors.

Center for Cancer Survivorship Studies (Ann Marie Flores)
406 Robinson Hall 320 square feet
The mission of the center is to describe and evaluate issues of cancer survivorship that affect physical and functional well-being and quality of life after a cancer diagnosis with special emphasis on minorities, the poor and medically underserved. The center is also devoted to the development and testing of physical therapy and technological interventions to improve physical and functional well-being and quality of life after a cancer diagnosis. The center encourages collaborative research that includes the fields of physical therapy, biostatistics, public health, epidemiology, sociology, biomedical & biomechanical engineering, psychology, nursing, oncology (surgical, medical and radiation), pharmacy sciences, cancer, and cell biology.

Neuromotor Systems Laboratory (C.J. Hasson)
426 Richards Hall 700 square feet
The goal of the Neuromotor Systems Laboratory is to understand how the nervous system learns, interacts with, and takes advantage of the properties of the musculoskeletal system and the external environment to achieve task goals. They are particularly interested in understanding how age-related changes in the neuromuscular system contribute to decrements in movement performance and stability. The laboratory’s larger room will contain an isolated experimental room and a separate office area for research staff and student activities. The experimental room will house an electromyography system (records muscle activity), a high-performance robotic arm, and high-performance computers for modeling, simulation, and data analysis. This equipment will be used to perform human motor control and learning experiments. A separate room will house Dr. Hasson’s office and a small workshop that will be
used to fabricate custom apparatuses and maintain experimental equipment. [http://www.neu.edu/neuromotorsystemslab/](http://www.neu.edu/neuromotorsystemslab/)

**Teaching and Learning Innovation Program (Lorna Hayward)**
Dr. Hayward’s research centers on the scholarship of teaching and learning as it relates to student learning, cultural competency, professional role formation and novice to expert transitions. Dr. Hayward designs and examines educational models that involve the use of technology, standardized patient interactions, and experiential education in physical therapist students. Dr. Hayward’s research is currently supported by the Kenneth B. Schwartz Center and the Wellesley Village Church.

**Rehabilitation and Epidemiology Trainee Program (Maura D. Iversen)**
The mission of the Rehabilitation and Clinical Epidemiology Trainee Program is to provide students with exposure to clinical translational research in the area of rehabilitation sciences and the development of patient reported outcome measures (PROs). A central focus of our research is the design, evaluation and implementation of behavioral and rehabilitation interventions to improve health outcomes and promote physical activity in persons with arthritis. Specific areas of expertise include studies of persons with rheumatoid arthritis, systemic lupus erythematosus, spinal stenosis and osteoporosis. Recent PROs include the pedi-IKDC, KOOS-Child, pediatric physical activity scale, a pediatric shoulder survey and outcomes measures to assess therapists confidence in their ability to manage patients in the acute care setting (ACCS). The team also collaborates with the Astrid Lindgren’s Hospital Gait Laboratory for the evaluation of gait dynamics in children and adults with arthritis. Dr. Iversen’s work /has been funded by the National Institutes of Health, the Research & Education Foundation, Foundation for Physical Therapy, Pzifer, the Arthritis Foundation and Farnsworth Foundation.

**Neurophysiology Laboratory (Robert Sikes)**
**Mugar Hall 300 Square Feet**
The Neurophysiology Laboratory of the Department of Physical Therapy explores the role of limbic system brain structures in pain and stress. The lab conducts pre-clinical electrophysiological experiments using animal models of cutaneous and visceral pain. This facility is one of very few that records simultaneous neuron activity at multiple levels of the pain transmission network and is part of a multidiscipline collaboration with labs at Northeastern and Boston University Medical School which conduct the brain imaging and behavior testing of these animals. The lab is located in 319 Mugar Building which provides close proximity to the animal facilities and brain imaging center. With 300 sq-ft the lab has adequate space for neurophysiological recording in small animals, surgical procedures, histological processing, light microscopy and preliminary data analysis. The lab is equipped with state of art neurophysiological recording, stereotaxic micropositioning, stimulus control and physiological monitoring systems. For histology there is a Nikon Optiphot microscope and a microtome for tissue preparation. There are multiple computer systems including a server that provides access for remote data analysis. Additional equipment includes a fume-hood, flammable storage cabinet, refrigerator and drying oven.
Laboratory for Locomotion Research (Sheng-Che Yan)
460 Richards Hall, 750 Square Feet
The goals of Laboratory for Locomotion Research are to: (a) understand how the central nervous system achieves sensorimotor control during gait; (b) develop and test gait rehabilitation programs for patients with sensorimotor control problems. The lab is located in the 4th floor of the university’s Richards Hall and has a total space of 600 ft2. A separate office (150 ft2) is adjacent to the lab that will be served as an examination room for healthy and patient subjects. The lab will be equipped with state of the art equipment and software for gait analysis.
Peer reviewed journal articles in 2014


**Book Chapters:**


**Conference Abstracts and Presentations**

**National and International conference presentation**


27. Flores, A. M., Nelson, J., Tucker, K., Poster, Physical & Functional Side Effects and Physical Therapy After Cancer Among Men And Women Of Puerto Rican Descent, 7th Biennial Cancer Survivorship Meeting, National Cancer Institute/NIH, American Cancer Society, LIVEstrong, CDC, Atlanta, GA.


40. Iversen MD. Google Minefield: Empowering Patients to Evaluate Online Resources. ACR/ARHP Annual Scientific Meeting, Boston, MA, November 16, 2014
41. Iversen MD. State of the Science II– Mobile Applications to Promote Physical Activity. ACR/ARHP Annual Scientific Meeting, Boston, MA, November 16, 2014
44. Lin, M. Y. , Dennerlein, J. T. , World Congress of Biomechanics, Sit/Stand Workstation Configuration affects Upper Extremity Posture, Muscle Load and Variability during Computer Mouse Use, Boston, MA. (July 8, 2014).

52. Nolan, D. C. (Presenter), Davis, I. (Presenter), Lecture, Running Assessment, New England Sports and Orthopedic Rehabilitation Summit 2014: Advances in Rehabilitation of the Lower Extremity, Brown University; University Orthopedics, Providence, RI.


55. Nolan, D. C. (Presenter), Lecture, Management of Common Non-Operative Shoulder Conditions, Primary Care Orthopaedics, MGH Department of Orthopaedic Surgery, Boston, MA).


61. Okechukwu, C. , Dennerlein, J. T. , 1st International Symposium to Advance Total Worker Health, Using Creative and Strategic Partnership for TWHTM Interventions in Complex Organizational Structures, National Institute for Occupational Safety and Health, Bethesda, MD. (October 8, 2014).


64. Sparer, E. , Dennerlein, J. T. , 24th International Epidemiology in Occupational Health (EPICOH), Qualitative findings from a safety communication and recognition program on safety awareness and teambuilding in construction, Chicago IL. (June 24, 2014).

65. Sparer, E. , Manjourides, J. , Dennerlein, J. T. , 24th International Epidemiology in Occupational Health (EPICOH), Patterns of site-employment of construction workers on and off commercial construction sites in new England and the relationship to musculoskeletal pain, Chicago IL. (June 24, 2014).


Local conferences and presentations.


3. Corkery, M., O'Rourke, B., Viola, S., Yen, S.-C., Rigby, J., Singer, K., Thomas, A. C., Poster, An examination of the association between altered lumbar motor control,


6. Dennerlein, J. T., Occupational Health Surveillance Seminar, Occupational physical activity in health care and construction: work’s contribution to workers’ weekly recommended levels of physical activity, Massachusetts Department of Public Health, Boston MA. (March 20, 2014).


Grants Submitted ($2.35 million)

2014 External Funding: $2,350,815 total direct costs requested with faculty as PI

<table>
<thead>
<tr>
<th>Agency</th>
<th>Title</th>
<th>Direct Costs</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIH</td>
<td>Pieces Project 2 as requested by Dr. Vogt</td>
<td>$5,815</td>
<td>Sikes</td>
</tr>
<tr>
<td>NIH</td>
<td>Virtual Aging of Muscle Dynamics and Motor Function (R01)</td>
<td>$1,300,000</td>
<td>Hasson (PI)</td>
</tr>
<tr>
<td>NIH</td>
<td>A New Reinforcement Learning-Based Approach to Robotic Gait R. R21</td>
<td>$275,000</td>
<td>Hasson (PI)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Yen (Co-I)</td>
</tr>
<tr>
<td>NIH/NCI</td>
<td>The Moving On pilot study for acceptability and feasibility of pre surgical recruitment for an early enhanced education intervention for breast cancer survivors (R21 NIH/NCI)</td>
<td>$285,000</td>
<td>Flores (PI)</td>
</tr>
<tr>
<td>Lupus Research Institute</td>
<td>Promoting Physical Activity (PA) and Exposure Assessment in Patients with Systemic Lupus Erythematosus (PULSE): A pilot study of a novel multimodal mobile intervention</td>
<td>$299,000</td>
<td>Iversen (PI)</td>
</tr>
<tr>
<td>Doug Flute Foundation</td>
<td>Enabling Young Athletes with Disabilities to Become Valued and Successful Members of the US Youth Soccer Family</td>
<td>$12,000</td>
<td>Hayward (PI)</td>
</tr>
<tr>
<td>NIH/NIAMS</td>
<td>Improving Recurrent Ankle Sprains through Error Driven Gait Rehabilitation (NIAMS R03)</td>
<td>$119,000</td>
<td>Yen (PI)</td>
</tr>
<tr>
<td>NASA</td>
<td>Assessment of High Performance EVA Glove (HPEG) injuries using finite element analysis</td>
<td>$55,000</td>
<td>Dennerlein (PI)</td>
</tr>
<tr>
<td>NIH/SBIR</td>
<td>iDART: interactive Daily Activity Robotic Therapist</td>
<td>$32,000</td>
<td>Hasson – Yen (Pls)</td>
</tr>
<tr>
<td>Denta Quest Foundation</td>
<td>Interprofessional CurbSide Consults</td>
<td>$2,000</td>
<td>Greenwood</td>
</tr>
<tr>
<td>2014 Society for Simulation in Healthcare</td>
<td>Development of an innovative educational process to educate debriefers on common outcomes and consistent communication during interprofessional team simulation experiences</td>
<td>$5,000</td>
<td>Greenwood (PI)</td>
</tr>
<tr>
<td>Boston Children’s Hospital, Orthopedics Research</td>
<td>Development and Testing of a Pediatric Shoulder Dysfunction Measure</td>
<td>$8,000</td>
<td>Iversen (PI)</td>
</tr>
</tbody>
</table>
## Funded Grants

2014 External Funding: Approximate Total direct costs for 2014 $1,08

<table>
<thead>
<tr>
<th>Agency</th>
<th>Title</th>
<th>2014 Direct Costs</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Institute for Occupational Safety and Health</td>
<td>Randomized Controlled Trial of Whole Body Vibration Intervention in Truck Drivers</td>
<td>$450,000</td>
<td>Dennerlein (PI)</td>
</tr>
<tr>
<td>Alpha Foundation</td>
<td>Whole body vibration exposure and injury prevention of heavy equipment operators in coal mines</td>
<td>$300,000</td>
<td>Dennerlein (PI)</td>
</tr>
<tr>
<td>National Institute for Occupational Safety and Health</td>
<td>HSPH Center for Work Health and Wellbeing. Project B</td>
<td>$140,000</td>
<td>Dennerlein (PI)</td>
</tr>
<tr>
<td>National Institute for Occupational Safety and Health</td>
<td>Center for Construction Research and Training: Development and Evaluation of Contractor Safety Pre-Qualification Tool.</td>
<td>$160,000</td>
<td>Dennerlein (PI)</td>
</tr>
<tr>
<td>National Institute for Occupational Safety and Health</td>
<td>HSPH Center for Work Health and Wellbeing. Project Administration Core</td>
<td>$11,000</td>
<td>Dennerlein (PI)</td>
</tr>
<tr>
<td>National Institute for Occupational Safety and Health</td>
<td>Center for Construction Research and Training: Enhancing Safety Climate through Leadership.</td>
<td>$15,000</td>
<td>Dennerlein (PI)</td>
</tr>
<tr>
<td>Denta Quest Foundation</td>
<td>Creation and Implementation of an Educational Module in Doctor of Physical Therapy Curriculum to Promote Oral Health Screening and Collaborative Interprofessional Patient Care</td>
<td>$2000</td>
<td>Greenwood Markowski</td>
</tr>
<tr>
<td>Wellesley Congregational Church</td>
<td>A Place Called Home: Security for Abandoned Ecuadorian Children with Severe Disabilities</td>
<td>$2,500</td>
<td>Hayward</td>
</tr>
<tr>
<td>Eastern Bank Charitable Foundation</td>
<td>Support for Professional Development of an Ecuadorian Physical Therapist to come to Boston</td>
<td>$1,000</td>
<td>Hayward</td>
</tr>
</tbody>
</table>
## 2014 Internal Funding: Approximate

<table>
<thead>
<tr>
<th>Program</th>
<th>Title</th>
<th>$</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIER 1 Seed Grant/Proof of Concept</td>
<td>A New Paradigm for Robotic Gait Rehabilitation Based on Reinforcement Learning</td>
<td>$50,000</td>
<td>Hasson Yen (PIs)</td>
</tr>
<tr>
<td>Northeastern University Provost Grant</td>
<td>Interprofessional Competence in Co-operative education (IPE-COOP): A Pilot Study</td>
<td>$14,672</td>
<td>Nippins (PI) Greenwood (Co-PI) Iversen</td>
</tr>
<tr>
<td>Advancing Undergraduate Teaching and Learning at Northeastern</td>
<td>From the Slices to the Loaf: Using 3-D printing to enhance learning and clinical application of cross-sectional neuroanatomy and diagnostic imaging</td>
<td>$10,000</td>
<td>Markowski - Sikes</td>
</tr>
<tr>
<td>Undergraduate Research and Creative Endeavors Award</td>
<td>An examination of the association between neuromuscular control of the core during functional movements, and knee pathologies in athletes</td>
<td>$1000</td>
<td>Corkery</td>
</tr>
<tr>
<td>Undergraduate Research and Creative Endeavors Award</td>
<td>Cultural Influences and Exercise Parameters for Community Dwelling Adults: A Literature Review and Community</td>
<td>$1000</td>
<td>Fitzpatrick Golub-Victor</td>
</tr>
<tr>
<td>Undergraduate Research and Creative Endeavors Award</td>
<td>Early PT education for pre-surgical breast cancer survivors A preliminary pilot study</td>
<td>$1000</td>
<td>Flores</td>
</tr>
<tr>
<td>Northeastern University Provost Undergraduate Research Program</td>
<td>The Voice of the Global Partner: Integration of Stakeholder Feedback in the International Service Learning Process</td>
<td>$925</td>
<td>Hayward</td>
</tr>
<tr>
<td>Northeastern University CATLR Faculty Scholars Program</td>
<td></td>
<td>$1500</td>
<td>Hayward</td>
</tr>
</tbody>
</table>