



Medical  
Rehabilitation  
Research  
Resource

N E T W O R K

## Precision Rehabilitation

How do we choose the best rehabilitation interventions for our patients? What makes an intervention better for one patient over another? Patient-specific intervention in rehabilitation is a growing need. During this two-day retreat we explore the concept of “precision rehabilitation.”

Listen as experts in related fields set the framework for how precision medicine has been successful, hear about resources that may be available from MR3 Centers and funding agencies, and help set the direction for future areas of precision rehabilitation research and implementation.

## Table of Contents

<a href="#">Acknowledgements.....</a>	<a href="#">p.2</a>
<a href="#">Agenda Day 1.....</a>	<a href="#">p.3</a>
<a href="#">Agenda Day 2.....</a>	<a href="#">p.4</a>
<a href="#">Session Abstracts.....</a>	<a href="#">p.5</a>
<a href="#">Day 1 Speakers.....</a>	<a href="#">p.8</a>
<a href="#">Day 2 Speakers.....</a>	<a href="#">p.15</a>
<a href="#">MR3 Steps to Diversity Equity and Inclusion .....</a>	<a href="#">p.22</a>
<a href="#">LeaRRn Needs Assessment Survey.....</a>	<a href="#">p.23</a>
<a href="#">MR3 Planning Committee.....</a>	<a href="#">p.24</a>
<a href="#">Funding Opportunities.....</a>	<a href="#">p.25</a>

## Acknowledgements

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Agenda	
<b>Day 1: Tuesday, June 29, 2021 (All times Eastern)</b> <b>Moderator: Rick Segal, PT, Ph.D., FAPTA, Medical University of South Carolina</b>	
11:00 - 11:15 a.m.	<b><u>Welcome, Introduction</u></b> Rick Segal, PT, Ph.D., FAPTA, Lead, National Coordinating Center Medical University of South Carolina
11:15 a.m. – 12:15 p.m.	<b><u>The Path to the Development of a Precision Oncology Program: Challenges and Opportunities</u></b> Massimo Cristofanilli, M.D., Northwestern University  <b>Discussants</b> R. James Cotton, M.D., Ph.D., Northwestern University, Shirley Ryan AbilityLab Steve Cramer, M.D., University of California, Los Angeles
12:15 – 1:00 p.m.	<b><u>Evolution of Pediatric Precision Rehabilitation</u></b> Keith Yeates, Ph.D., University of Calgary Thubi H.A. Kolobe, PT, Ph.D., FAPTA, The University of Oklahoma
1:00 – 1:15 p.m.	***Break***
1:15 – 2:00 p.m.	<b><u>Precision Regenerative Rehabilitation</u></b> Carmen Terzic, M.D., Ph.D., Mayo Clinic Christopher Evans, Ph.D., Mayo Clinic
2:00 – 2:45 p.m.	<b><u>Neuromodulation is Particularly Amenable to Precision Rehabilitation</u></b> Ela Plow, Ph.D., PT, Cleveland Clinic Lisa McTeague, Ph.D., Medical University of South Carolina
2:45 – 3:00 p.m.	***Break***
3:00 – 4:00 p.m.	<b>Breakout Rooms</b> <b>Topic   Discussion Facilitator</b> <b>Funding Agencies</b>   Randal Davis, MBA, Medical University of South Carolina <b>Pediatric Precision Rehabilitation</b>   Stephanie DeLuca, Ph.D., Virginia Tech <b>Outcomes and Assessment</b>   Craig Velozo, Ph.D., OTR/L, Medical University of South Carolina <b>Sensors and Wearables</b>   Scott Delp, Ph.D., Stanford University <b>Genomics and Biomarkers</b>   Paolo Bonato, Ph.D., Harvard Medical School

Agenda	
Day 2: Wednesday, June 30, 2021 (All times Eastern)	
Moderator: Jill Heathcock, MPT, Ph.D., The Ohio State University	
11:00 a.m. – 12:00 p.m.	<b>Rehabilomics Research: Towards a Precision Medicine Approach to Optimizing Function after Acquired Brain Injury</b> Amy Wagner, M.D., University of Pittsburgh  <b>Discussants</b> Jordan Grafman, Ph.D., Northwestern University, Shirley Ryan AbilityLab Helen Bronte-Stewart, M.D., MSE, Stanford University
12:00 – 12:45 p.m.	<b>Precision Rehabilitation Requires Precision Measurement</b> Arun Jayaraman, PT, Ph.D., Northwestern University, Shirley Ryan AbilityLab Luca Lonini, Ph.D., Northwestern University, Shirley Ryan AbilityLab
12:45 – 1:00 p.m.	***Break***
1:00 – 1:45 p.m.	<b>Open-Source Tools for Real-World Monitoring in Rehabilitation</b> Jen Hicks, Ph.D., Stanford University Carmichael Ong, Ph.D., Stanford University Joy Ku, Ph.D., Stanford University
1:45 – 2:30 p.m.	<b>Implementing Precision Rehabilitation in Learning Health Systems</b> Janet Freburger, PT, Ph.D., University of Pittsburgh Joel Stevans, D.C., Ph.D., University of Pittsburgh
2:30 – 2:45 p.m.	***Break***
2:45 – 4:00 p.m.	<b>Moderated Panel Discussion</b> Panelists: Steven Wolf, PT, Ph.D., FAPTA, Emory University Craig Vellozo, Ph.D., OTR/L FAOTA, Medical University of South Carolina Sharon Landesman Ramey, Ph.D., Virginia Tech
End of Day	<b>Closing Remarks</b> Theresa Hayes Cruz, Ph.D., Director, NICHD National Center for Medical Rehabilitation Research

## Session Abstracts

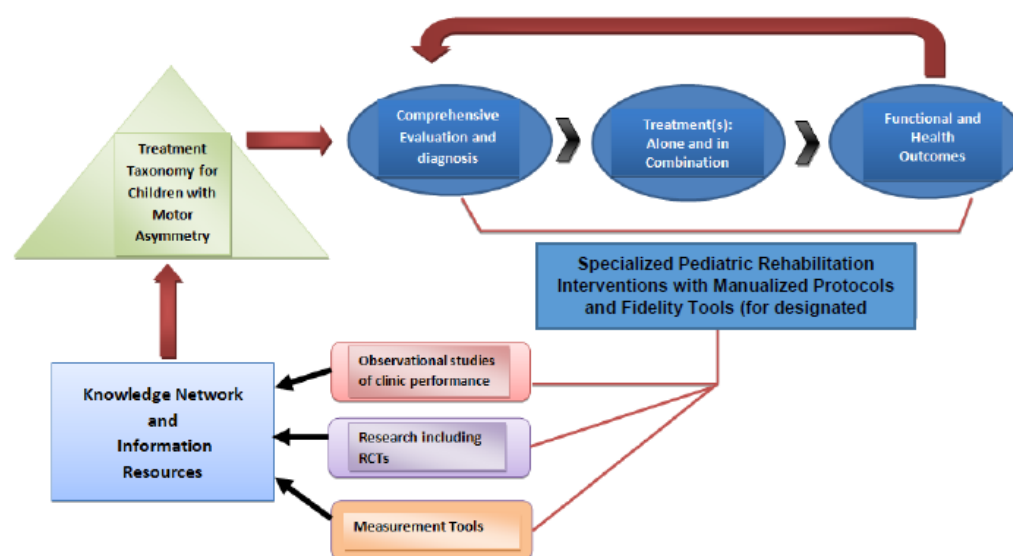
### C-PROGRESS

#### Evolution of Pediatric Precision Rehabilitation

The era of Precision Medicine (Collins & Varmus, 2015) affords excitement to individualize medical practice, informed by a person's genomic profile. Early on, however, cautionary warnings occurred (Bayer & Galea, 2015), given the knowledge about large racial/ethnic, socioeconomic, and regional disparities in health and inequities in healthcare delivery. In 2013, Ramey, Coker-Bolt, and DeLuca proposed (Figure 1 below) that pediatric rehabilitation science could adapt Precision Medicine guiding principles. Concurrently, impressive advances in developmental neuroscience offered new insights that helped develop more efficacious and enduring treatment approaches based on principles of neuroplasticity, inter-domain dependencies, and early learning. Remarkably, despite knowing that almost all clinical trials result in variation in children's outcomes – even for highly efficacious interventions – there is a dearth of scientific knowledge that adequately accounts for this variability. Precision-Rehabilitation may help to close this knowledge gap.

The National Pediatric Rehabilitation Resource Center, known as C-PROGRESS, promotes the design and conduct of rigorous clinical trials in pediatric rehabilitation. A foundational premise is that to realize maximum benefits of rehabilitation interventions, both the child's neurobiology and environment must be assessed. Theoretically, genomic profiles and individual needs, coupled with the child's system of natural supports, combine to influence a treatment-induced neuroplasticity and long-term well-being. To accelerate discoveries, the field of pediatric rehabilitation research also must continue to refine measurement of functional outcomes to yield sensitive, valid, and meaningful data so that treatments can be tailored for children at different ages/stages in development. C-PROGRESS will highlight technology research and clinical trials that include biomarkers (DNA analyses, innovative neuroimaging), real-world outcomes monitoring (wearable devices, video diaries), and combined therapies (neuromodulation and/or response-contingent feedback devices plus behavioral therapies).

Collins & Varmus, 2015, NEJM; Bayer & Galea, 2015, NEJM



#### A Translational Systems Framework for the Evolution of Pediatric Precision-Rehabilitation

Figure Adapted from *The Handbook of Pediatric Constraint-Induced Movement Therapy* (Ramey, Coker-Bolt, & DeLuca)

## **AR<sup>3</sup>T**

### **Precision Regenerative Rehabilitation**

Regenerative Rehabilitation combines cellular therapies and/or tissue-engineered products with targeted forms of rehabilitation with the goal of optimizing patient outcomes. This integrated treatment approach provides a number of parameters for customization. Currently, Precision Regenerative Rehabilitation is still a futuristic concept, but the field is moving from a generic, one-size-fits-all approach towards a patient-specific replacement of tissue lost to injury, disease, or age. Dr. Carmen Terzic from the Mayo Clinic will describe recent clinical results indicating that stem cell therapies designed to promote cardiac regeneration are most effective for a subpopulation of patients, specifically when applying this intervention to patients with heart failure. The relationship between left ventricular volumes (LVEDV) and clinical outcomes in heart failure is well recognized and recent studies defined a range of LVEDV that appeared to segregate heart failure patients with the highest potential to benefit from cell-based therapy. Dr. Christopher Evans from the Mayo Clinic will describe his musculoskeletal research on the use of platelet-rich plasma (PRP), which is widely used as a treatment for osteoarthritis of the knee, where the majority of patients accrue some benefit, but others do not. As a first step towards distinguishing between responders and non-responders he has established a database where he has characterized both the patient and the PRP. This will be analyzed by machine learning to identify those characteristics associated with a superior clinical outcome. It is expected that the addition of specific rehabilitation regimens will further individualize and enhance therapeutic outcomes.

## **NC NM4R**

### **Neuromodulation is Particularly Amenable to Precision Rehabilitation**

We believe that neuromodulation is a tool that lends itself to precision rehabilitation approaches because many neurological events leading to disability can be so different from person to person – for example, the location and severity of a spinal cord injury or a stroke. With people having the same diagnosis possibly having very different neural substrates involved, it should not be expected that a single rehabilitation approach or dose would prove effective in most subjects. It is likely that very different neural circuits are involved for different people with the same diagnosis. Thus, to advance precision rehabilitation via neuromodulation we need tools that can probe these circuits in individuals, theoretical understandings of how the circuits can be modulated, and tools to modulate the circuits. We propose two presentations that show different paths to precision rehabilitation in the stroke population.

- Ela Plow will use TMS as a neurophysiological probe to choose whether to target the lesioned or intact hemisphere for subsequent neuromodulation interventions.
- Lisa McTeague will use combined TMS and fMRI to visualize the state of target networks or circuits to identify the most promising nodes for applying neuromodulation interventions.
- Both presenters will then be available for discussion in breakout rooms on these different approaches.

## **C-STAR**

### **Precision Rehabilitation Requires Precision Measurement**

We believe that precision rehabilitation requires precision measurement. Such measurements are needed to quantify the severity of impairment as well as functional loss. However clinical rehabilitation practice does not currently require accurate measurements of either impairment or function. The reasons for this are complex and are related to inadequacies of equipment design, a limited time allowed for assessment by health insurance providers, and by lack of advanced training amongst therapists. There are also strong cultural barriers that are related to historical precedent. If therapists are trained by clinicians who believe that prevailing measurements are both accurate and sufficient, then there is no strong motivation to change.

This approach is limiting and prevents progress towards precision rehabilitation, in which clinical therapy is targeted and linked specifically to the pathology that triggers the clinical episode. If we use other fields of medicine as a guide, the greatest therapeutic advances have come in parallel with more detailed knowledge and more precise measurement of both impairment and functional loss.

To address these constraints, we are proposing two short presentations.

- Arun Jayaraman will illustrate the advantages coming from the studies of wearable sensors in tracking improvements in patients receiving advanced technological interventions such as robots assisting recovery in spinal cord injury or stroke
- Luca Lonini will describe the benefits to be derived from using machine learning to evaluate sensor data.

## **Restore Center**

### **Open-Source Tools for Real-World Monitoring in Rehabilitation**

Smartphones, activity trackers, and other mobile technology are experiencing tremendous growth and are poised to help us move rehabilitation from clinics and labs into real-world settings. The additional data from these devices could help create precision therapies based on an individual's function and enable us to better understand the relationship between specific treatments and outcomes. Despite the ubiquity of mobile sensors and the compelling use cases for them within rehabilitation, their impact on rehabilitation has not yet been realized. One barrier is the tools for processing data from mobile sensors. The tools are often proprietary, limiting transparency and extensibility—essential capabilities for conducting research and building trust. Their accuracy and suitability for patient populations are not always clear, and there is no consensus for how to process data to obtain accurate and meaningful outcome measures.

The Restore Center's mission is to establish a worldwide collaboration to gain insights from real-world data on rehabilitation outcomes for those with movement impairments. As part of that mission, we are sharing relevant software that is open-source, extensible, and validated for several use cases. During this session, we will highlight existing open-source tools for analyzing movement and discuss data and software needs to accelerate the adoption of mobile technology within rehabilitation:

- Carmichael Ong will describe the use of inertial measurement sensors, such as those found in smartphones and activity trackers, to analyze movement and will highlight capabilities of the [OpenSense](#) tool for making such measurements.
- Jennifer Hicks will discuss a [pipeline](#) which uses the open-source [OpenPose](#) software to quantitatively analyze movement from single-camera videos (e.g., in smartphones) of children with cerebral palsy.
- Joy Ku will conclude with a brief overview of other open-source resources for real-world monitoring and ideas of how we, as a community, can increase the impact of mobile technology on rehabilitation.

## **LeaRRn**

### **Implementing Precision Rehabilitation in Learning Health Systems**

Investigators Joel Stevans and Janet Freburger, from LeaRRn, the Learning Health Systems Rehabilitation Research Network, will highlight key considerations for successful translation of evidence to practice. They will discuss how principles of learning health systems and implementation science research can inform the evaluation and delivery of precision rehabilitation. Using the example of treatment-based classification, an evidence-based approach that matches a patient's unique clinical signs and symptoms to the most effective rehabilitation intervention, they will illustrate how one large rehabilitation organization is using learning health system strategies to overcome the challenges of delivering the right care, at the right time, for the right patient.



## Day 1 Speakers



### **Moderator**

**Rick Segal, PT, PhD, FAPTA**

Dr. Segal is Professor and Chair in the Department of Rehabilitation Sciences at the Medical University of South Carolina. After several years as a practicing Physical Therapist in Washington, D.C., he went to the University of Virginia to earn his Ph.D. in Anatomy and Neuroscience. He spent twenty-two years as a faculty member at Emory University before serving eight years as Director of the Division of Physical Therapy at the University of North Carolina at Chapel Hill.

Dr. Segal is active in faculty and research mentorship and is a strong advocate for translational research. He has over 30 years of experience carrying out rehabilitation-oriented Neuroscience research on motor control and spinal circuits. Dr. Segal was part of the NIH funded program project grant entitled “spinal circuits and the musculoskeletal systems” for 24 years. He was a mentor in the ERRIS grant writing workshops for 10 years, and PI/Co-PI and mentor for the TIGRR grant writing workshops for the past eight years. He is working on translating research into practice through students using education research. In 2018 he coordinated the first grantsmanship and mentorship in education research (GAMER) grant writing workshop. He serves on the Executive Committee of the NIH funded Interdisciplinary Rehabilitation Engineering Career Development Program (K12), where he is helping engineers make their research more applicable for rehabilitation of patients. He is the Education Director of the NIH funded P2C National Center of Neuromodulation for Rehabilitation (NM4R) along with being the lead of the Coordinating Center for the six P2C’s across the country.

Dr. Segal was selected as a Catherine Worthingham Fellow of the American Physical Therapy Association (APTA) in 2009 and is on the Professional Development Committee and Diversity and Inclusion subcommittee of the Society for Neuroscience.



### **Keynote Speaker**

**Massimo Cristofanilli, M.D., FACP**

Dr. Cristofanilli received his medical degree in 1986 from the University “La Sapienza” Medical School in Rome (Italy) where he subsequently completed a Fellowship in Medical Oncology in November 1990. In July 1996, he started a Medical Oncology Fellowship at the University of Texas M. D. Anderson Cancer Center. Between 1998 and 2010 he held a faculty position in the Department of Breast Medical Oncology at the University of Texas M. D. Anderson Cancer Center where serving as an Associate Professor of Medicine and Executive Director of the Morgan Welch IBC clinic and research program that he founded in 2006. In 2010 he joined the Fox Chase Cancer Center in Philadelphia as Chairman of Medical Oncology, Leader of the Breast Service

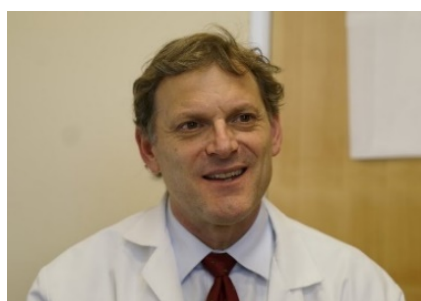
Line and co-Leader of the Women Cancer Program. Subsequently, he served as Director of the Jefferson Breast Cancer Center and Clinical program and Deputy Director of Translational Research at the SKCC. He is currently the Associate Director of Translational Research and Precision Medicine at the Robert Lurie Comprehensive Cancer Center and Director of the oncoSET Precision Medicine Program.

His major research interest consists of the detection, characterization and possible therapeutic targeting of occult (microscopic) disease in breast cancer. His initial work using a novel immunomagnetic-based technology



(CellSearch™) led to a pivotal trial which successfully demonstrated the detection and prognostic value of circulating tumor cells (CTCs) in the peripheral blood of patients with metastatic breast cancer (MBC). Several seminal papers resulted from this initial study that have also fostered research in other tumor types and expanded the potential implication of microscopic disease in advanced cancer. His interest in molecular diagnostics has recently expanded to define the role, applications and clinical implications of tissue-based (NGS, RPMA) and blood-based testing (ctDNA).

He has been involved in the development of new targeted agents in metastatic disease (e.g. lapatinib, gefitinib, palbociclib). In particular, he led an investigator-initiated multicenter trial that successfully demonstrated the superiority of combining an EGFR-inhibitor (Gefitinib) with anastrozole in postmenopausal women with hormone-receptor positive disease starting hormonal therapy. More recently, he was the lead investigator for the prospective, multicenter clinical trial evaluating palbociclib (IBRANCE) in combination with fulvestrant (Faslodex) in patients with hormone-receptor positive MBC-PALOMA-3. He also combined his expertise in liquid biopsy and endocrine-resistance to evaluate the role of specific mutations in relation to palbociclib-resistance bringing novel information to the design of additional studies in this setting.



**Steve Cramer, M.D.**

Dr. Steven C. Cramer is a Professor of Neurology at the University of California, Los Angeles. He is also the Director of Research at California Rehabilitation Institute, co-PI of the NIH StrokeNet clinical trials network, and a Section Editor at the journal Stroke. Dr. Cramer graduated with Highest Honors from University of California, Berkeley; received his medical degree from University of Southern California; did a residency in internal medicine at UCLA; and did a residency in neurology plus a fellowship in cerebrovascular disease at Massachusetts General Hospital. He also earned a master's degree in Clinical Investigation from Harvard Medical School.

His research focuses on neural repair after central nervous system injury in humans, with an emphasis on stroke and on recovery of movement. Treatments examined include robotics, cellular therapies, a monoclonal antibody, brain stimulation, drugs, and telehealth methods. A major emphasis is on translating new drugs and devices to reduce disability after stroke, and on developing biomarkers to individualize therapy for each person's needs. Dr. Cramer has been awarded the Stroke Rehabilitation Award from the American Heart Association, the Barbro B. Johansson Award in Stroke Recovery from the World Stroke Organization, the Award for Excellence in Post-Acute Stroke Rehabilitation from the American Congress of Rehabilitation Medicine, and he is the Susan and David Wilstein Endowed Chair in Rehabilitation Medicine. He also co-edited the book "Brain Repair after Stroke" and is the author of over 300 manuscripts.

**R. James Cotton, M.D., Ph.D.**



Dr. R. James Cotton, MD, PhD is a Clinician-Researcher who will be joining the Center for Bionic Medicine as a lab director. Dr. Cotton recently completed his residency in physical medicine and rehabilitation at the Shirley Ryan AbilityLab, which included an additional year integrated into his residency for research, where he developed a wearable sensor platform that records electromyography and kinematics to provide biofeedback and help guide therapies. His long-term goal is to develop neural interface technologies and translate them to people with spinal cord injury to help restore some of their lost function. Dr. Cotton

received his undergraduate degrees in electrical engineering and biochemistry from Rice University and his MD/PhD, with a focus on systems neuroscience, from the Baylor College of Medicine.



**Keith Yeates, Ph.D.**

Dr. Yeates is the Ronald and Irene Ward Chair in Pediatric Brain Injury, Professor and Head of the Department of Psychology, and Adjunct Professor of Pediatrics and Clinical Neurosciences at the University of Calgary, in Alberta, Canada. He leads the University's Integrated Concussion Research Program. He has a 30-year track record of funded research focusing on the outcomes of childhood brain disorders, especially traumatic brain injury, and has published 343 peer-reviewed journal articles, 45 book chapters, and 6 edited or co-authored books. A recent published bibliometric analysis indicated he has authored more of the top-100 cited papers in pediatric TBI than any other researcher. Dr. Yeates was co-lead author of the report of the Centers for Disease Control (CDC) Expert Panel on Acute Diagnosis and Management of Mild Traumatic

Brain Injury among Children and Adolescents, is the inaugural Chair of the Canadian Concussion Network, and will be an invited expert panel member at the 6th International Consensus Conference on Concussion in Sport. He was previously Associate Editor of the Journal of the International Neuropsychological Society and is currently the Editor-in-Chief of Neuropsychology. Dr. Yeates has served as President of the Society of Clinical Neuropsychology (Division 40 of the American Psychological Association), and as President of the International Neuropsychological Society. He has been ranked as one of the top 10 most influential neuropsychologists in North America over the past 50 years.



**Thubi H.A. Kolobe, PT, Ph.D., FAPTA**

Dr. Kolobe is the Edith Kinney Gaylord Presidential Professor and the Ann Taylor Chair for Developmental Disabilities in the Department of Rehabilitation Science at the University of Oklahoma Health Sciences Center. She holds a Ph.D. in pediatric physical therapy from Hahnemann University and MS degree from the University of North Carolina at Chapel Hill. She is a co-developer of the Test of Infant Motor Performance (TIMP) for preterm infants, a norm-referenced test that is used worldwide. Her current research, funded by Foundations, the National Institute of Health (NIH), and the National Science Foundation (NSF), examines the effectiveness of human-robotic movement learning in very young infants with focus on brain-behavior connection and development of prone locomotion in infants with and without risk for Cerebral Palsy.

Other research areas are early intervention, early identification of children at risk for developmental delays or disabilities, cultural and environmental influences on development, and measurement. Her publications appear in many prestigious journals and widely used textbooks. Dr. Kolobe is a Catherine Worthingham Fellow of the American Physical Therapy Association (APTA), has served as chair of the Academy of Pediatric Physical Therapy (APPT) Research Committee, chaired the APPT Task Force to develop its research agenda, served on the APTA Task Force to revise the association's research agenda, and has chaired the APPT Research Summits on Physical Activity and Fitness, Early Intervention, and Dosing. She has also served as a standing member on two NIH Scientific Review Committees for 9 years, and a 3-year term on a committee of the National Research Council of the National Academies of Science. Dr. Kolobe has extensive clinical experience in pediatrics and community-based interventions. Over the past 30 years, her roles in the latter has ranged from direct patient care in various settings, clinical education, staff development, to program consultation. Her consultation roles have focused largely on program evaluation and development for community-based programs that serve children and families with disabilities and funded undergraduate and graduate training programs.



**Carmen Terzic, M.D., Ph.D.**

Dr. Terzic has been a member of the Mayo Clinic staff since 1992 and was the Chair of the Department of Physical Medicine and Rehabilitation from 2011 -2020. She holds the academic rank of Professor and is board certified by the American Board of Physical Medicine & Rehabilitation. She is Co-Director of the Rehabilitation Medicine Research Center and she is also the Associate Director of the Cardiovascular Rehabilitation Program, Mayo Clinic, Rochester, MN.

Dr. Terzic earned her medical degree from Universidad Centroccidental Lisandro Alvarado, in Barquisimeto, Venezuela and a PhD. from Mayo Graduate School, Mayo Clinic, Rochester, MN. She completed fellowship and postgraduate training at the Department of Physical Medicine and Rehabilitation and the Cardiovascular Research Laboratory, Division of Cardiovascular Diseases, Mayo Graduate School of Medicine, at Mayo Clinic in Rochester, MN.

Her clinical interests include cardiovascular and neuromuscular rehabilitation, and her research focuses on regenerative medicine and stem cell-based cardiac repair, nuclear transport, intracellular calcium homeostasis. As a principal investigator and co-investigator, her work has been funded by the National Heart, Lung, and Blood Institute, and the American Heart Association, among other organizations. Dr. Terzic has reported research findings in over 90 manuscripts and textbook chapters. Her work has been published in leading journals, such as Science, Nature Cell Biology, Science Translational Medicine, Circulation, Journal of Cardiopulmonary Rehabilitation and Prevention, Circulation Research, Clinical Pharmacology and Therapeutics, Genome Biology and Stem Cells.

She is active on a number of national and international specialty societies and is recognized globally for her groundbreaking research and contributions to clinical guidelines and practice in the area of cardiovascular prevention and rehabilitation.



**Christopher Evans, Ph.D.**

Christopher H. Evans, Ph.D., D.Sc., is a consultant in the Department of Physical Medicine and Rehabilitation at Mayo Clinic in Rochester, Minnesota, with joint appointments in the Department of Orthopedic Surgery and the Department of Molecular Medicine. Dr. Evans also serves as director of the Rehabilitation Medicine Research Center. He joined the staff of Mayo Clinic in 2013 and holds the academic rank of professor of physical medicine and rehabilitation, orthopedics and molecular medicine, Mayo Clinic College of Medicine and Science. Dr. Evans is recognized with the distinction of the John and Posy Krehbiel Professorship in Orthopedics.

Dr. Evans earned his B.Sc. in genetics and microbiology and his Ph.D. in biochemistry at the University of Wales, United Kingdom. He completed a postdoctoral fellowship in molecular biology at Free University of Brussels, Belgium. Subsequently, he earned his master's in history and philosophy of science at University of Pittsburgh, followed by his Doctor of Science degree at the University of Wales. He has an honorary M.A. from Harvard Medical School, where he is the Maurice Müller Professor of Orthopaedic Surgery Emeritus. Dr. Evans uses his background in cell and molecular biology to study clinical problems involving bones and joints. His research has two main focuses: arthritis and tissue regeneration. He has developed a gene therapy for arthritis that is undergoing clinical trials at Mayo Clinic. Tissue regeneration focuses on bone healing and cartilage repair; this work is at a preclinical stage.

Dr. Evans consistently publishes in high-impact scientific journals and has authored or edited several books and numerous book chapters. He is frequently invited to give presentations on his research both domestically and internationally. In addition, he is an associate editor for European Cells and Materials, Bone and Joint Research and Osteoarthritis and Cartilage Open. He previously served as chair of the Editorial Advisory Board of the Journal of Orthopaedic Research.



**Ela Plow, Ph.D., PT**

Dr. Plow is a physical therapist and a neuroscientist with expertise in the area of neuroplasticity and brain-based markers of recovery in neurologic disease. She received her PhD from the University of Minnesota in the area of Stroke Rehabilitation Science and Neuroscience. She went on to complete a post-doctoral fellowship from Harvard Medical School in neurology and non-invasive brain stimulation. In 2010, she moved to the Cleveland Clinic and started a lab specializing in study of non-invasive brain stimulation for rehabilitation in stroke and spinal cord injury. Her work is funded by the NIH, Dept. of Defense and the American Heart Association and includes >65 peer-reviewed publications in noted journals like

Stroke, Neurorehabilitation and Neural Repair, Neurology and Brain Stimulation. Dr. Plow reviews regularly for the NIH and several high-impact journals.



**Lisa McTeague, Ph.D.**

Dr. McTeague is an Associate Professor in the Department of Psychiatry and Behavioral Sciences at Medical University of South Carolina and a psychologist at the Ralph H. Johnson VAMC. She is a licensed clinical psychologist with more than 15 years' experience using multimodal psychophysiology, brain imaging and brain stimulation to understand cognitive and emotional control and its application to multimodal treatment outcomes in anxiety and mood disorders. Her work in cognitive and affective neuroscience has consistently been transdiagnostic,

examining multimodal neurobehavioral phenotypes of emotional and cognitive dysfunction within but also between neuropsychiatric disorders. She has observed that across disorders, emotional and cognitive impairment is related to disruptions in the neurocircuits that support intact or adaptive emotion and cognition. As such, she has utilized these findings as a roadmap for non-invasive brain stimulation development as adjunctive treatments for the most promising behavioral interventions. While continuing to optimize brain stimulation interventions for anxiety and depression, she has branched out more recently to utilize parallel techniques in neurodegenerative disorders including chronic stroke and mild cognitive impairment.



## Breakout Room Facilitators



**Scott Delp, Ph.D.**

Scott Delp is the James H. Clark Professor, Founding Chairman of the Department of Bioengineering at Stanford, and Director of the National Center for Simulation in Rehabilitation Research. Delp transformed the field of biomechanics by creating highly accurate computer models of musculoskeletal structures and providing them to researchers worldwide using a software system (OpenSim) that he and his team developed. Delp invented fundamental technology for surgical navigation that is now in wide clinical use. Together with Mark Schnitzer and their students, Delp developed novel microendoscopes that allow realtime in vivo imaging of human muscle microstructure. Together with Karl Deisseroth and their students, Delp pioneered the use of optogenetics to control activity in the peripheral nervous system leading to important inventions for treating paralysis, spasticity, and pain.



**Stephanie DeLuca, Ph.D.**

Dr. Stephanie C. DeLuca is a developmental scientist who leads the Didactic Interactions Core of the National Pediatric Rehabilitation Resource Center. Dr. DeLuca has examined the impact of intensive neurorehabilitation treatments on children and adults with neuromotor impairments for nearly 30 years. She has helped develop and rigorously test multiple neurorehabilitation protocols and led and co-led numerous clinical trials. Dr. DeLuca's interdisciplinary research efforts have included: engagement of families, international training, and innovative teaching to prepare the next generation of clinicians and scientists. In addition, she has served as a consultant for Humanity Inclusion funded by USAID and as a co-investigator on two global-health initiative grants funded by the Medical

University of South Carolina. Dr. DeLuca envisions "precision rehabilitation treatments" that can help all individuals with disabilities and their families become empowered members of their communities. Dr. DeLuca served on the Board of Directors for the American Academy of Cerebral Palsy & Developmental Medicine and currently serves on the Advisory Board for the National Center for Medical Rehabilitation Research.



**Paolo Bonato, Ph.D.**

Paolo Bonato serves as Director of the Motion Analysis Lab (MAL) at Spaulding Rehabilitation Hospital. The MAL brings state-of the art technology and internationally-recognized expertise to the study and treatment of mobility-limiting conditions, including cerebral palsy, stroke, traumatic brain injury, spinal cord injury and Parkinson's Disease. An internationally-known rehabilitation engineer, Dr. Bonato has consolidated the lab's preeminent position in biomechanics and rehabilitation. He is Assistant Professor in the Department of Physical Medicine and Rehabilitation at Harvard Medical School and is a member of the Affiliated Faculty of the Harvard-MIT Division of Health Sciences and Technology in Cambridge.



**Randal Davis, MBA**

In February 2019, Randal Davis was appointed the Director of Strategic Research Initiatives for the Medical University of South Carolina (MUSC) College of Health Professions. Prior to this, he was on the ground floor of the NIH's Roadmap Initiative that, in 2006, transformed the General Clinical Research Centers program into the Clinical and Translational Science Award (CTSA) – leading to MUSC establishing the South Carolina Clinical & Translational Research (SCTR) Institute. As the first SCTR Project Director, he oversaw strategic planning and evaluation, directed the project management office, guiding the T32 (TL1) and K12 (KL2) career development programs, engaged community and national stakeholders, and guided the science related programs (retreats, pilot studies, translational technologies.)

Simultaneously, Mr. Davis served as the university Director of Grants Development for the Office of Research Development leading the development of complex center grants, training grants, and other types of infrastructure grants sponsored by the NIH, National Science Foundation, Department of Defense, and other federal funding agencies. He has a broad background in leading national projects and strategic planning; measuring and reporting programmatic successes; proactively pursuing continuous process improvement; engaging communities for positive action and partnership building; and major center grant program development (contributions to date have leveraged more than \$350M in extramural award funding).



## Day 2 Speakers



**Moderator**  
**Jill Heathcock, MPT, Ph.D.**

Jill Heathcock MPT, PhD is an Associate Professor and Director of the Pediatric Assessment and Rehabilitation Laboratory (PEARL lab) at The Ohio State University (OSU) in Columbus, Ohio. Dr. Heathcock has been a Fulbright Scholar, participated in several large clinical trials funded by the NIH and PCORI, and is part of the National Pediatric Rehabilitation Resource Center (C-progress.org). Dr. Heathcock's work focuses on the impact of dose, intensity, and the timing of pediatric rehabilitation interventions. She also Co-Directs the Assessment Core at OSU as part of the I-ACQUIRE trial.



**Keynote Speaker**  
**Amy Wagner, M.D.**

Amy K. Wagner M.D. is a tenured Professor, Vice-chair Faculty Development, and Endowed Chair for Translational Research in the Department of Physical Medicine and Rehabilitation at the University of Pittsburgh. She holds a secondary appointment in the Department of Neuroscience and in the University of Pittsburgh's Clinical and Translational Science Institute. She is also Associate Director for Rehabilitation Research at the Safar Center for Resuscitation Research. Dr. Wagner's research program uses biomarkers as tools for developing and optimizing personalized treatments and outcomes for individuals with disability, particularly with traumatic brain injury (TBI) and with cardiac arrest. She has defined her work with rehabilitation centered biomarkers research as Rehabilomics Research ([www.rehabilomics.pitt.edu](http://www.rehabilomics.pitt.edu)). Dr. Wagner's research operationalizes the Rehabilomics

Research Model for translational studies, identifying biomarkers relevant for assessing pathology and prognosis related to disability and function as well as for assessing clinical risk and use in clinical decision making. Her experimental research focuses on how dopamine systems, hormones, inflammation, and rehabilitation relevant therapeutic agents impact plasticity and recovery. Her experimental TBI work also includes the study of rehabilitation relevant cognitive training paradigms to better understand the substrates and mechanisms of learning and memory recovery. Dr. Wagner has published over 110 original research and 45 invited articles and chapters. Her extensive transdisciplinary and translational research portfolio of federally funded research (including National Institutes of Health, Centers for Disease Control, The National Institute for Disability, Independent living, and Rehabilitation Research, and the Department of Defense) has garnered, to date, over \$16 million as a principal investigator for TBI and cardiac arrest research. Dr. Wagner was the 2018-2019 President for the National Neurotrauma Society, and she hosted the 2019 National Neurotrauma Symposium in Pittsburgh. Dr. Wagner has mentored dozens of trainees, many of which have received awards and scholarships for their research. She is Training Faculty for the Center for Neuroscience at the University of Pittsburgh, and she also directs the Brain Injury Medicine Fellowship at the University of Pittsburgh Medical Center. In 2018 she was selected by the American Congress of Rehabilitation Medicine as a liaison to the American College of Surgeons—Committee on Trauma to support multiple shared initiatives. She is also active member of the Neurocritical Care Society sponsored Curing Coma Campaign, an

international research and advocacy effort to improve long-term recovery for individuals with disorders of consciousness. She is a 2020 inductee into the National Academy of Medicine. Clinically, Dr. Wagner treats patients with neurological conditions undergoing inpatient rehabilitation, and she is a consultant for neurologically devastated patients during their acute hospitalization at the University of Pittsburgh Medical Center.



**Jordan Grafman, Ph.D.**

Since the latter part of 2012, Dr. Grafman has been the director of Brain Injury Research at the Shirley Ryan AbilityLab and is on faculty at Northwestern University's Feinberg School of Medicine in the Departments of Physical Medicine and Rehabilitation, Psychiatry and Behavioral Sciences, and the Cognitive Neurology and Alzheimer's Disease Center as well as the Department of Psychology in the Weinberg College of Arts and Sciences. Before joining Shirley Ryan AbilityLab, Dr. Grafman was briefly director of Traumatic Brain Injury Research at the Kessler Foundation in West Orange New Jersey. Prior to that appointment in 2011, Dr. Grafman was Chief of the Cognitive Neuroscience Section at the National Institute of Neurological Disorders and Stroke in Bethesda, Maryland for many years. His investigation of brain function and behavior contributes to advances in medicine, rehabilitation, and psychology, and informs ethics, law, philosophy, and health policy. His study of the human prefrontal cortex and cognitive neuroplasticity incorporates neuroimaging and genetics, an approach that is expanding our knowledge of the impact of traumatic brain injury, as well as other diseases that impair brain function.



**Helen Bronte-Stewart, M.D., MSE**

Dr. Helen Bronte-Stewart is the John E Cahill Family Professor in the department of Neurology and Neurological Sciences. She is a neurologist, neurophysiologist and movement disorders specialist, who has used her training in mathematics and physics, bioengineering, neurology, movement disorders, and single unit electrophysiology in primates to develop a rigorous translational program in motor control research in human subjects with movement disorders. Dr. Bronte-Stewart is the Director of the Stanford Comprehensive Movement Disorders Center, the Co-Director of the Stanford Balance Center, and the Division Chief of Movement Disorders in the department of Neurology and Neurological Sciences. She directs the Human Motor Control and Neuromodulation Laboratory, where she has developed computerized, quantitative measurements of motor behavior, which are being implemented in a wide range of Movement Disorders. Her research investigates the brain's contribution to abnormal movement in human subjects, using synchronous brain recordings and quantitative kinematics, and how these are modulated with different frequencies and patterns of neurostimulation. Dr. Bronte-Stewart's team was the first in the United States to implant a sensing neurostimulator, from which they can record brain signals directly, and use the patient's own neural activity to drive the first closed loop neurostimulation studies in Parkinson's disease. This work has led to her team receiving a BRAIN Initiative grant to perform the first closed loop deep brain stimulation studies for gait impairment and freezing of gait in Parkinson's disease. She is the Lead Investigator for the first pivotal international trial of adaptive DBS in Parkinson's disease – the ADAPT-PD trial and enrolled the first patient in December 2020.

**Arun Jayaraman, PT, Ph.D.**



Director, Max Näder Center for Rehabilitation Technologies & Outcomes Research  
Director & Business Development Officer, Office of Translational Research  
Shirley Ryan AbilityLab  
Associate Professor of PM&R, Medical Social Science, PTHMS  
Northwestern University Feinberg School of Medicine

Dr. Arun Jayaraman's work primarily focuses on developing and executing both investigator-initiated and industry-sponsored research in prosthetics, orthotics, rehabilitation robotics, and other assistive and adaptive technologies to treat physical impairments. He conducts all of his outcomes research using advanced wearable patient monitoring wireless sensors and novel machine learning techniques, in addition to the traditional performance-based and patient-reported outcome measures. He collaborates both nationally and internationally with many academic and industrial organizations and is internationally recognized in the field of rehabilitation robotics.

He is an Associate Professor of Physical Medicine & Rehabilitation, Physical Therapy & Human Movement Sciences, and Medical Social Sciences at Northwestern University's Feinberg School of Medicine.

**Luca Lonini, Ph.D.**



Research Scientist II and Senior Data Scientist  
Shirley Ryan AbilityLab  
Research Assistant Professor of Physical Medicine and Rehabilitation  
Northwestern University Feinberg School of Medicine

Dr. Lonini is a Research Scientist and Data Scientist in the Office of Translational Research at the Shirley Ryan AbilityLab, and a Research Assistant Professor in the Department of Physical Medicine and Rehabilitation at Northwestern University. His research is focused on wearable computing and contactless sensing to quantify rehabilitation outcomes and help clinicians deliver personalized care. He was formerly a Postdoctoral researcher in the Max Nader Lab and then a Motion Scientist at Apple, where he worked on applications of wearable technology and machine learning to monitor the progression of diseases affecting mobility. He published in interdisciplinary venues merging computer science, engineering and clinical research, on topics ranging from Parkinson's symptom monitoring, fall detection and stroke patient outcomes using wearable technology.

**Jen Hicks, Ph.D.**



Director of Data Science, Mobilize Center  
Associate Director, National Center for Simulation in Rehabilitation Research  
Research and Development Manager, OpenSim Software Project  
Department of Bioengineering, Stanford University

Jennifer Hicks received her Ph.D. in Mechanical Engineering from Stanford University in 2010. Her work, applying computer modeling and statistical learning to understand human movement disorders, was supported by fellowships from the National Science Foundation and the Stanford Bio-X Program. Dr. Hicks is the Director of Data Science for the Mobilize Center, an NIH Biomedical Technology Resource Center at Stanford University. Dr. Hicks also serves as the Associate Director of the Restore Center, an NIH-funded center that brings



state-of-the-art engineering tools to rehabilitation scientists. Her research is focused on interfacing biomechanical modeling with statistical and machine learning methods to predict the effects of surgery and other interventions on human movement. She is also using data from mobile phones and other novel sources to understand how to motivate physical activity. Dr. Hicks helps run the multi-faceted training and outreach programs at the Mobilize Center and NCSRR. In addition, as the Research and Development Manager for the OpenSim software project, she guides the project's development team and serves as the voice of the software user/researcher.



**Carmichael Ong, MS, Ph.D.**

Research Engineer, Mobilize Center  
Department of Bioengineering, Stanford University

Carmichael Ong received his Ph.D. in Bioengineering from Stanford University in 2019. His work focused on developing simulations that predict human movement to gain insights into gait pathologies and to assist in exoskeleton design. This work was supported by the Stanford Bio-X Program and the Siebel Scholars Foundation. Dr. Ong is currently a Research Engineer for the Mobilize Center, an NIH Biomedical

Technology Resource Center at Stanford University, and is interested in leveraging wearable sensors and other modalities to improve rehabilitation research and outcomes. He also helps run training programs for the Restore Center, an NIH-funded center that brings state-of-the-art engineering tools to rehabilitation scientists, and is a member of the development team for the OpenSim and OpenSense software projects.



**Joy Ku, Ph.D.**

Project Manager, SimTK  
Director of Promotions and Didactic Interactions, Restore Center  
Director of Communications and Engagement, Mobilize Center  
Director of Communications and Training, National Center for Simulation in Rehabilitation Research  
Department of Bioengineering, Stanford University

Joy Ku's career has focused on biocomputation and the advancement of their use through teaching, science communications, community building, and the promotion of research resource sharing efforts, particularly as related to reproducibility and open-source science. She earned her Ph.D. in Electrical Engineering from Stanford University in 2004 for studying and validating blood flow simulation results. Dr. Ku currently manages the dissemination and training efforts for three national research centers. She is the Director of Dissemination and Training for the National Center for Simulation in Rehabilitation Research, the Director of Promotions and Didactic Interactions for the NIH-funded Restore Center, and the Director of Communications and Engagement for the Mobilize Center, an NIH Biomedical Technology Resource Center. She is also an Executive Committee Member of the Committee for the Credible Practice of Modeling & Simulation in Healthcare (CPMS), under the U.S. Interagency Modeling and Analysis Group. CPMS's mission is to outline good practices for simulation-based medicine, including validation and reproducibility. Dr. Ku was selected as an AAAS Mass Media Fellow in 2003 and has served as the Associate Editor of the Biomedical Computation Review magazine. Dr. Ku has also served as the Director of Simbios, the NIH National Center for Physics-Based Simulations of Biological Structures, during which time she oversaw the expansion of the SimTK project hosting website. She continues to manage the site, which now has over 100,000 members and provides a rich resource for biosimulation models, data, and software.



**Joel Stevans, Ph.D., DC**

Joel Stevans, DC, PhD, is a researcher specializing in health services research and implementation science. In these roles, he has had the opportunity to work on a number of implementation studies including two that are focused on rehabilitative care. His clinical and academic training, coupled with 20 years of quality improvement experience within the healthcare industry, have given him the necessary skills to lead the Techniques Development Component and serve in other leadership and mentoring roles.

Dr. Stevans is currently a co-investigator in a large multi-site, effectiveness-implementation hybrid trial funded through PCORI (C11-2016-0001). The aim of this project is to evaluate the clinical and implementation outcomes of a psychologically-informed physical therapy approach to back pain management recruited from 82 primary care practices distributed within five geographic regions across the country. In this study, all patient identification, screening, and physical therapy referral activities were executed via electronic medical record by primary care clinical and administrative staff. Dr. Stevans leads the implementation evaluation for this study, working closely with Dr. Freil, and serves as the Chair of the study's Data Integrity Committee. He also leads the implementation evaluation as co-investigator on a study funded through the National Center for Complementary and Integrative Health (1UG3AT008769-01A1). This study is a multi-site randomized controlled trial of patients with acute low back pain (LBP), using a hybrid design to address both effectiveness and implementation, with the interventions provided by both chiropractors and physical therapists. This study tests the clinical effectiveness of spinal manipulative therapy (SMT), supported self-management (SSM), and a combination of SMT plus SSM, compared to usual medical care for preventing the transition from acute to chronic pain. Dr. Stevans' doctoral work consisted of a multi-level diagnostic evaluation, guided by the Consolidated Framework for Implementation Research, to identify factors associated with adherence to clinical guidelines in 60 ambulatory rehabilitation facilities.



**Janet Freburger, PT, Ph.D.**

Dr. Freburger is Professor, Department of Physical Therapy and Director of the Implementation Science Core of the Clinical Translational Science Institute, University of Pittsburgh. She has over 20 years of experience as a health services researcher with expertise in observational and pragmatic study designs that capitalize on existing data (i.e., administrative healthcare claims, electronic health record, registries, and other population-based data). Much of Dr. Freburger's research has focused on improving understanding of access to, appropriate use of, and effectiveness of rehabilitation care for musculoskeletal and neurologic conditions in adults. Her more recent work has focused on bridging the evidence to practice gap through both small- and large-scale implementation and quality improvement studies. She has been funded by the National Institutes of Health (NIA, NIAMS, NCMRR), the Agency for Healthcare Research and Quality, the Patient-Centered Outcomes Research Institute, the Centers for Disease Control, Medicare Payment Advisory Council, the Department of Health

and Human Services, the Foundation for Physical Therapy, the American College of Physicians, and the American Physical Therapy Association. Dr. Freburger currently serves on the Executive Committee of the Center on Health Services Research and Training (CoHSTAR) and the Scientific Advisory Panel for the American Physical Therapy Association's Outcomes Registry.



**Steven Wolf, PT, Ph.D., FAPTA**

Dr. Wolf is a physical therapist clinician and neuroscientist who received his PT training at Columbia and Boston Universities and his doctoral training at Emory University where he is a Professor in several departments. He explores novel interventions to improve extremity use in patients with stroke as well as mechanisms of cortical reorganization and inter-joint coordination associated with these resulting improvements. Within the past 23 years he has led several NIH funded clinical trials governing these concepts. Relevant to this proposal, work over the past 3 years on the use of implanted vagus nerve stimulation to access pathways to sensory and motor cortices in stroke survivors contributes to an emerging scope of explorations that facilitates planned knowledge translation activities. These activities lay the groundwork for clinical implementation of future evidence generated from clinical trials built upon our foundational studies in cortical stimulation to enhance upper extremity post-stroke

functional capacity.



**Sharon Landesman Ramey, Ph.D.**

Dr. Sharon Landesman Ramey is Director of the National Pediatric Rehabilitation Resource Center known as C-PROGRESS. She is the lead Multiple PI for three NIH multisite Randomized Controlled Trials in pediatric rehabilitation related to high intensity forms of neurorehabilitation. As a developmental scientist and methodologist, she brings more than four decades of experience in developing and rigorously testing new treatments for children with disabilities and those with risk conditions. She has conducted pioneering research over the past 20 years developing pediatric Constraint-Induced Movement Therapy (P-CIMT) with Dr. Stephanie DeLuca and other colleagues. She is particularly interested in continuing to refine the methods available for designing clinical trials- including

alternative, innovative, and adaptive designs – that are adequately powered, well-suited for multicenter clinical trials, and supported by strong coordinating centers to document fidelity of the treatments and standardization of assessment methods. She has also helped to develop and publish new statistical approaches for multivariate longitudinal datasets, detecting interaction terms, novel approaches to longitudinal analyses and growth curve analyses, and small sample sizes. Similarly, she has developed and validated many assessment tools for young children, including children with disabilities, and for parents. In 2013, Dr. Ramey presented the idea of “precision rehabilitation” as a highly promising framework to inform future research and clinical collaboration in pediatrics (Ramey, Coker-Bolt, & Deluca, 2013)





**Craig Velozo, Ph.D., OTR/L, FAOTA**

Dr. Velozo is a professor and director of the Occupational Therapy Division at the Medical University of South Carolina. Over the last 30 years he has been a principal investigator on NIH, Department of Education, Department of Defense, and pharmaceutical grants/contracts to develop patient reported outcomes (PRO) from conception to final instruments. Dr. Velozo is a member of the American Occupational Therapy Academy of Research, an American Occupational Therapy Fellow, and received the Eleanor Clarke Slagle Lectureship Award in 2020.



**Theresa Hayes Cruz, Ph.D.**

Dr. Cruz became director of NCMRR in August 2020, after serving as acting director since September 2019. She has been a full-time NIH staff member since 2009. Through basic, translational, and clinical research, NCMRR fosters the development of scientific knowledge needed to enhance the health, productivity, independence, and quality-of-life of people with physical disabilities. In her capacity as a health scientist administrator in NCMRR, Dr. Cruz manages grants in the Devices and Technology Development and Rehabilitation Diagnostics and Interventions Programs. She also manages Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) awards in medical rehabilitation. In addition to her duties at NCMRR, Dr. Cruz is a team lead in the NIH Brain Research through Advancing Innovative Neurotechnologies® (BRAIN) Initiative where she co-manages a grant portfolio in the areas of neurotechnology development, validation, and translation for applications in neuroscience, neurophysiology, movement disorders, pain, neuromodulation, and

other interfaces with the nervous system. In 2015, Dr. Cruz performed a research detail at the Functional and Applied Biomechanics Laboratory in the Rehabilitation Medicine Department of the NIH Clinical Center. In late 2016, she returned fulltime to NCMRR. Dr. Cruz received her bachelor's degree in biomedical engineering with highest honors from the School of Engineering at Rutgers, the State University of New Jersey. She received her master's and doctoral degrees in biomedical engineering from Northwestern University. Her previous research at the Rehabilitation Institute of Chicago focused on motor control and gait impairments of the lower limb following stroke.

## MR3 Network Action Steps for Diversity, Equity, and Inclusion

MR3 is committed to the advancement of DEI across medical rehabilitation. Our goal is to establish resources that foster the transformation of medical rehabilitation to become more representative of the people our profession serves. Our initiatives include:

- Recruiting participants that reflect the population(s) involved in rehabilitation.
- Developing pathways for younger, underrepresented individuals to enter the rehabilitation research workforce
- Retaining and facilitating growth of underrepresented rehabilitation researchers
- Rapidly and effectively exchanging new knowledge about rehabilitation science to diverse patient populations

We value your input!

Let us know of your ongoing efforts to help us establish best practices.  
Please send any feedback or requests for information and resources to the MR3 National Coordinating Center:

[mcleodmi@musc.edu](mailto:mcleodmi@musc.edu)

## LeaRRn Needs Assessment Survey - Please Provide Input!



### LEARNING HEALTH SYSTEMS REHABILITATION RESEARCH NETWORK (LeaRRn) NEEDS ASSESSMENT SURVEY

We are interested in your familiarity with and interest in learning health systems (LHS) research. LeaRRn has created a Rehabilitation Research Needs Assessment Survey to assess familiarity with and interest in LHS research. Responses will help us develop educational and training activities that are aligned with these needs.

This survey should take you about 10-15 minutes to complete. Thank you in advance for your input!

[Access Survey Here](#)

# Thank You to Our MR3 Planning Committee!

**We would like to acknowledge and thank the members of the MR3 who participated in the planning of this event**

## **Alliance for Regenerative Rehabilitation Research and Training (AR<sup>3</sup>T)**

- Jessica Washington
- Kaitlin Geran

## **National Pediatric Rehabilitation Resource Center (C-PROGRESS)**

- Stephanie DeLuca, Ph.D.
- Sharon Ramey, Ph.D.

## **The Center for Smart Use of Technologies to Assess Real World Outcomes (C-STAR)**

- William Zev Rymer, M.D., Ph.D.
- Shannon Stanfill, M.Sc.

## **Learning Health Systems Rehabilitation Research Network (LeaRRn)**

- Margarite Whitten, Ph.D.
- Mary Slavin, PT, Ph.D.

## **National Center of Neuromodulation for Rehabilitation (NC NM4R)**

- Cynthia Gittinger
- Michelle McLeod, Ph.D., ATC
- Randal Davis, MBA
- Richard Segal, PT, Ph.D., FAPTA

## **Restore Center**

- Joy Ku, Ph.D.

## Funding Opportunities

Follow the links for below more information

[NIH Rehabilitation Research News](#)

[Rehabilitation Research at NSF](#)

[Department of Veterans Affairs Resources for Precision Rehabilitation Research](#)

[Back to Top](#)