Rehabilitation Clinical Trials: Innovations, Designs, and Tribulations

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Agenda

Day 1: Thursday, September 29, 2022 (All times Eastern)

11:00 - 11:10 a.m.	**Welcome** **Rick Segal, PT, PhD, FAPTA** Professor, Department of Health Sciences and Research Medical University of South Carolina, Charleston, SC Education Director, National Center of Neuromodulation for Rehabilitation Lead, MR3 Coordinating Center
11:10 a.m. – 12:00 p.m. 30-min presentation 20-min discussion	**Keynote Speaker** **Catherine Lang, PT, PhD, FAPTA** Professor of Physical Therapy, Neurology, Occupational Therapy Associate Director, Movement Science Program Washington University School of Medicine in St. Louis, St. Louis, MO *The Complexities, Challenges, and Promise of Rehabilitation Clinical Trials* **Session Moderator:** Rick Segal, PT, PhD, FAPTA
12:00 p.m. – 12:10 p.m.	*****Break*****
12:10 – 1:10p.m. 20-min, including discussion, each	**Session 1 – Novel Trial Design** **Stephanie DeLuca, PhD** Fralin Biomedical Research Institute, Virginia Tech University *Distinctive Challenges InDesign and Data Analysis of Pediatric Rehabilitation Trials* **Anat Lubetzky, PT, PhD** New York University, Department of Physical Therapy *We Found a Way: Conducting and Modifying an In-person Randomized Controlled Trial for Vestibular Disorders During the COVID-19 Pandemic in New York City* **Susan Magasi, PhD** University of Illinois at Chicago Departments of Occupational Therapy, and Disability & Human Development *Application of Hybrid Effectiveness-Implementation Designs to Bridge the Research-Practice Divide for mRehab Interventions* **Session Moderator:** Jennifer Stevens-Lapsley, PT, PhD, FAPTA

1:10 – 1:20 p.m.	*****Break*** Advertise Funding Agencies**
1:20 – 2:20 p.m. 20-min, including discussion, each	**Session 2 – Barriers and Difficulty of Success** **Veronica T. Rowe, MS(R), PhD, OTR/L, CBIST, FNAP** Department of Occupational Therapy Georgia State University *Standardization to Achieve Optimal Data Quality in Multi-Site Rehabilitation Clinical Trials* **Noelle Moreau, PhD, PT** Department of Physical Therapy Louisiana State University Health Sciences Center – New Orleans *Multi-Site Clinical Trials: Treatment Fidelity and Beyond* **Matt Stock, PhD** Neuromuscular Plasticity Laboratory Institute of Exercise Physiology and Rehabilitation Science University of Central Florida *Participant Retention, Compensation, and Compliance during Knee Joint Immobilization Research: An Analysis of Two Clinical Trials* **Session Moderator:** Sharon Ramey, PhD
2:20 – 2:30 p.m.	*****Break*****
2:30 – 3:30 p.m. 20-min, including discussion, each	**Abstract Topic 3 - Outcomes** **Ela Plow, PhD, PT** Biomedical Engineering Physical Medicine & Rehabilitation Cerebrovascular Center Cleveland Clinic *A Story of Those Who Get Left Behind* **Kristie Bjornson, PT, PhD, MS** Seattle Children's Research Institute Department of Pediatrics, University of Washington *Beyond the Clinic: Measuring Walking Performance and Mobility in Daily Life* **Antoine Falisse, PhD** Department of Bioengineering, Stanford University *OpenCap: 3D Human Movement Dynamics from Smartphone Video* **Session Moderator:** Linda Resnik, PT, PhD, FAPTA
3:30 – 3:40 p.m.	*****Break*****
3:40 – 4:10 p.m.	**"Student" Session: Idea Blitz!** **Vaibhavi Rathod, PT** NYU Steinhardt School of Physical Therapy

3 student speakers – 10 min each, including discussion	*Utilization of EPIC Slicer Dicer in Achilles Tendinopathy - A Recruitment Case Study* **Komal Kukkar, PT, MS** Department of Health and Human Performance, University of Houston *Changes in the Fronto-central Brain activity for Balance Control in Chronic Stroke Survivors* **David Johnson, BS** Department of Biomedical Engineering, School of Sciences and Engineering, St. Louis University, *Regenerative Rehabilitation for Enhancing Muscle Recovery Following Volumetric Muscle Loss* **Session Moderator:** Jill Heathcock, MPT, PhD
4:10 – 4:45 p.m.	**Funding Agency Q&A** **NIH National Center for Medical Rehabilitation Research (NCMRR)** Joe Bonner, PhD – Health Scientist Administrator and Program Officer **NIH National Center for Advancing Translational Sciences (NCATS)** Christopher Hartshorn, PhD – Chief, Digital & Mobile Technologies Section **Veterans Affairs Rehabilitation Research & Development (VA RR&D)** Timothy Brindle, PhD – Scientific Program Manager **National Institute on Disability, Independent Living and Rehabilitation Research (NIDILRR)** Radha Holavanahalli, PhD – Rehabilitation Program Specialist **Congressionally Directed Medical Research Programs (CDMRP)** Patricia Henry, PhD – Program Manager **Craig H. Neilsen Foundation** Jacob Shreckengost, PhD – Program Officer *Spinal Cord Injury Research on the Translational Spectrum (SCIRTS)* **Session Moderator:** Randal Davis, MBA

Day 2: Friday, September 30, 2022 (All times Eastern)

11:00 – 11:05 a.m.	**Welcome** **Rick Segal PT, PhD, FAPTA**
11:05 – 11:55 a.m. 30-min presentation 20-min discussion	**Keynote Speaker – NIH Pragmatic Collaboratory** **Wendy Weber, ND, PhD, MPH** Chief, Clinical Research in Complementary and Integrative Health Branch Division of Extramural Research National Center for Complementary and Integrative Health National Institutes of Health **Session Moderator:** Janet Freburger, PT, PhD
11:55 a.m. – 12:05 p.m.	*****Break*****
12:05 p.m. – 1:05 p.m. 20-min, including discussion, each	**Session 4 – Novel Trial Design** **Elizabeth Skidmore, PhD, OTR/L** Professor of Occupational Therapy, University of Pittsburgh *Assessing Organizational and Provider Context and Readiness to Inform National, Multi-site Pragmatic Trials: Methods and Lessons Learned* **Stacey Dusing, PT, PhD** Biokinesiology and Physical Therapy, University of Southern California *Moving Infant Rehabilitation Forward Through Rigorous Research Design: Moving from Single Site Single Variable Trials to Multi-arm, Multi-phase Intervention* **Christy Cassarly, PhD** Department of Public Health Sciences Medical University of South Carolina *Responder Analysis vs. Mean Change Analysis in Stroke Rehabilitation Clinical Trials* **Session Moderator:** Arun Jayaraman, PT, PhD
1:05 – 1:15 p.m.	*****Break*****
1:15 – 2:15 p.m.	**Session 5 – Ethics and Diversity**

20-min, including discussion, each	**Warren Lo, MD** Depts. Pediatrics and Neurology The Ohio State University and Nationwide Children's Hospital *Recruiting Under-Represented Minorities (U-RM) for Rehabilitation Research* **Michael Young, MD** Department of Neurology, Massachusetts General Hospital *Ethical Considerations in Neurorehabilitation Clinical Trials: Emerging Principles & Priorities* **Amy Darragh, OT, PhD** Division of Occupational Therapy, School of Health and Rehabilitation Sciences The Ohio State University *Stakeholder Engagement and Integration in Clinical Trials* **Session Moderator:** Stephanie DeLuca, PhD
2:15 – 2:25 p.m.	*****Break*****
2:25 – 3:25 p.m. 20-min, including discussion, each	**Session 6 – Telerehabilitation** **Kelly Rishe, MSOT, OTR/L** Laboratory for Translational Neurorecovery Massachusetts General Hospital *Novel Clinical Trial of Portable Near-Infrared Spectroscopy-based (fNIRS) Brain Computer Interface to Augment Upper Extremity Motor Recovery after Stroke* **Sangeetha Madhavan, PT, PhD** Physical Therapy, College of Applied Health Sciences University of Illinois at Chicago *Innovative Telerehabilitation Model for Slowing Disease Progression in Amyotrophic Lateral Sclerosis (ALS) Using Non-invasive Brain Stimulation* **Devina Kumar, PhD, MSc, PT** Burke Neurological Institute, White Plains, NY Brain Mind Research Institute Weill Cornell Medicine *Overcoming Barriers During COVID-19: A Completely Virtual Tele-Exercise Intervention Study for Adults with Chronic Neurological Impairments* **Session Moderator(s):** Matthew Petrucci, PhD
3:25 – 3:35 p.m.	*****Break*****

3:35 – 4:15 p.m.	**<u>Session 7 – Adaptive Trials Design</u>** **James Guest, MD, PhD, FACS, FRCS** Clinical Professor, Department of Neurological Surgery The Miami Project to Cure Paralysis University of Miami *Adaptive Clinical Trials in Spinal Cord Injury* **Emma H. Beisheim-Ryan, PT, DPT, PhD** VA Eastern Colorado Geriatric Research, Education, and Clinical Centers (GRECC) VA Eastern Colorado Health Care System, Aurora, Colorado *Improving Functional Outcomes in Skilled Nursing Facilities Nationwide: A Hybrid I Effectiveness-Implementation Pragmatic Clinical Trial Approach.* **Session Moderator:** Zev Rymer, MD, PhD
4:15-4:30	**Closing Remarks** Theresa Hayes Cruz, PhD, Director, NICHD National Center for Medical Rehabilitation Research

Acknowledgements

The National Institutes of Health Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD), which is home to the National Center for Medical Rehabilitation Research (NCMRR), in collaboration with the National Center for Complementary and Integrative Health (NCCIH), the National Institute of Biomedical Imaging and Bioengineering (NIBIB), the National Institute on Deafness and Other Communication Disorders (NIDCD), and the National Institute of Neurological Disorders and Stroke (NINDS), and the National Institute of Nursing Research (NINR), supports the Medical Rehabilitation Research Resource Network (MR3N). The MR3N is made up of six P2C resource center grants that provide infrastructure and access to expertise, technologies, and resources to foster clinical and translational research in medical rehabilitation.

Day 1 Speakers

Rick Segal, PT, PhD, FAPTA

Dr. Segal is Professor in the Department of Health Sciences and Research and past Chair of 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 10 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 also a mentor and on the advisory board of the NIH funded RMSTP program. Finally, he is the Education Director of the NIH funded P2C National Center of Neuromodulation for Rehabilitation (NM4R) along with being the lead of the Medical Rehabilitation Research Resource (MR3) Network 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.

Catherine Lang, PT, PhD, FAPTA

Dr. Lang is a Professor of Physical Therapy, Occupational Therapy, and Neurology, and Associate Director for the Movement Science PhD Program at Washington University School of Medicine in St. Louis MO, USA. She received physical therapy degrees from the University of Vermont in 1993 (BS) and 1997 (MS), her PhD in Movement Science from Washington University in 2001, and completed a postdoctoral fellowship at the University of Rochester between 2001 and 2004. Her accomplishments have earned her the title of fellow for both the American Society for NeuroRehabilitaiton (ASNR) and the American Physical Therapy Association (APTA).

Dr. Lang directs the Neurorehabilitation Research Laboratory where efforts are targeted toward the development of effective and efficient, individualized rehabilitation for people with stroke and other neurological injuries. Numerous studies are focused on characterizing neurobehavioral changes over the course of stroke recovery, developing new and optimizing current motor interventions, and improving clinical practice. The interdisciplinary, interactive laboratory environment promotes collaborations within and outside the lab with engineers, scientists, and clinicians, resulting in a productive research program. She provides research training to PhD students, postdocs, and junior faculty members. Continuous funding from the NIH has supported her research efforts since 2005.

Stephanie DeLuca, PhD

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.

Anat Lubetzky, PT, PhD

Anat Lubetzky, PT, PhD, CSCS, is an Associate Professor at New York University, Department of Physical Therapy and the Director of NYU Steinhardt's PhD Program in Rehabilitation Sciences. Research in Dr. Lubetzky's lab utilizes advances in virtual reality technology to study multi-sensory integration for postural control in adults with and without vestibular dysfunction and hearing loss across the life span. Her interdisciplinary group developed an application to treat sensory integration in people with vestibular disorders. This work has gone through several development stages with a recently completed pilot randomized controlled trial funded by NIH REACT. For her innovative work in technology and rehabilitation, Dr. Lubetzky received the Steinhardt School Gabriel Carras Research Award for a promising young scholar in 2017-2018 and the NYU Technology Acceleration and Commercialization Award in 2017. Her work has been funded by the NIH and the Hearing Health Foundation. Her current focus is studying the contribution of sounds to postural control given hearing or vestibular loss in different contexts and applying the knowledge gained to balance rehabilitation of people with vestibular disorders and fall prevention in people with hearing loss.

Susan Magasi, PhD

Susan Magasi, PhD is an associate professor of occupational therapy and disability studies at the University of Illinois at Chicago. Her work is centered on addressing health. healthcare, and participation equity for people with disabilities using peer support and self-management interventions delivered in-person and via smartphone applications. Of high relevance to this presentation, she is the mPI along with co-authors Rachel Adler and David Victorson on a project developing a web-based self-management intervention for cancer survivors with known disabilities using a co-design process.

Veronica Rowe, MS(R), PhD, OTR/L, CBIST, FNAP

Dr. Veronica Rowe obtained a master's degree in occupational therapy from Washington University in St. Louis, Missouri in 1996 and a PhD in occupational therapy from Texas Woman's University (TWU) in 2016. In her experience as an occupational therapist, she has worked in various areas of adult and geriatric care including acute care, inpatient and outpatient rehabilitation, long term care, burns, hands, and psychiatric care, all areas with an emphasis in neurological disorders. She also has a master's degree in research from St. Louis University which has assisted her in many research endeavors. Prior to her work in academia, she spent her career in St. Louis, Missouri at St. Anthony's Medical Center; Baltimore, Maryland at Johns Hopkins Bayview; and in Atlanta, Georgia at Emory University. She served as a project coordinator for numerous research studies at Emory University involving rehabilitation therapies for the neurologically compromised upper extremity, including constraint induced movement therapy, mental imagery, and use of robotic devices. She also collaborated on several research studies involving task specific training and neurorehabilitation assessment measures at the University of Southern California. Currently, she is working on the TRANSPORT2 national clinical trial where she trains, coordinates, and adjudicates the raters of outcome measures involving the hemiparetic upper extremity. She is the author of numerous peer-reviewed articles, and has presented nationally, internationally, and virtually for a wide variety of audiences. She is also a Certified Brain Injury Specialist Trainer. Her dissertation and research area of interest is neurorehabilitation after stroke or head injury, specifically, contemporary approaches of neurorehabilitation, such as task oriented training, as well as outcome measures related to the neurologically involved population. Dr. Rowe is currently working at Georgia State University in the Occupational Therapy department as a research faculty member.

Noelle Moreau, PT, PhD

Noelle G. Moreau, PT, PhD is a Professor of Physical Therapy at Louisiana State University Health Sciences Center in New Orleans. Dr. Moreau's research focuses on the investigation of the neuromuscular mechanisms underlying abnormal muscle function and movement impairments in children with cerebral palsy Dr. Moreau has experience in project administration as principal investigator in several rehabilitation intervention studies. She is currently the principal investigator of two, multi-site R01 clinical trials funded by the National Institutes of Health (NIH). The overarching goal of Dr. Moreau's research is the development of effective rehabilitation strategies to address neuromuscular impairments and improve activity, participation, and quality of life.

Matt Stock, PhD

Dr. Matt S. Stock is an Associate Professor in the School of Kinesiology and Physical Therapy at the University of Central Florida. Dr. Stock serves as Director of the Institute of Exercise Physiology and Rehabilitation Science, as well as the Neuromuscular Plasticity Laboratory. He obtained his Ph.D. from the University of Oklahoma under the careful mentorship of Professor Travis Beck. His research interests involve understanding the neuromuscular adaptations associated with disuse, aging/sarcopenia, and exercise rehabilitation. Studies in his laboratory utilize electromyography, motor unit recordings, transcranial magnetic stimulation, twitch

interpolation, B-mode ultrasonography, and a multitude of muscle strength assessments. Dr. Stock has published over 100 peer-reviewed manuscripts in respected physiology, kinesiology, and rehabilitation journals.

Ela Plow, PhD, 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.

Kristie Bjornson, PT, PhD, MS

Kristie Bjornson, PT, PhD, MS is Professor, Developmental Medicine, Pediatrics, Adjunct Research Professor, Rehabilitation Medicine at the University of Washington, and Seattle Children's Hospital Research Institute. Clinically, she has over 40 years of clinical experience in settings such as the NICU, public schools, birth-to-three centers, and at Seattle Children's Hospital. Ms. Bjornson's doctoral work focused on the assessment of walking activity, health, and quality of life in ambulatory children with cerebral palsy (CP). She was the first to publish community-based walking activity in children with CP. Dr Bjornson's clinical trial experience includes the randomized trial and meta-analysis of selective dorsal rhizotomy and botulinum toxin-A injection therapy as well as early safety trials for intrathecal baclofen. Ongoing research includes power training combining the Total Gym and treadmill training, a home-based treadmill training study and a project examining the Ankle-Foot Orthoses Footwear Combination (AFO-FC) orthotic management approach for ambulatory children with CP.

Antoine Falisse, PhD

Antoine Falisse received a B.S. degree in Engineering Science (2012, UC Louvain, Belgium), a M.Sc. in Biomedical Engineering (2014, UC Louvain, Belgium), and Ph.D. in Biomedical Sciences (2019, KU Leuven, Belgium). The main focus of his doctoral research was the development of models and methods for personalized modeling and predictive simulation to study gait in children with cerebral palsy. Following his Ph.D., he stayed at the KU Leuven for a short postdoc before moving to Stanford University. His postdoctoral research is primarily about using commodity videos to inform simulations of human movement and support clinical decision making. This research materialized in the development of OpenCap (https://www.opencap.ai/).

Vaibhavi Rathod, PT

Vaibhavi Rathod is a licensed physical therapist and doctoral candidate pursuing her PhD at the Department of Physical Therapy at New York University under the mentorship of Smita Rao. Vaibhavi's dissertation examines jump performance in individuals with Achilles tendinopathy. Her long-term goal is to improve evidence-based musculoskeletal rehabilitation.

Komal Kukkar, PT, MS

I am Komal Kukkar, a 2nd year PhD student in Kinesiology (Motor Behavior) at the Health and Human Performance Department of the University of Houston. I have a bachelor's degree in physical therapy from India in 2007, M.S. in Kinesiology (Biomechanics and Motor Control) from the University of Illinois at Chicago in 2013 and another M.S. degree in Data Science from the Maryville University at St. Louis in 2021. In addition, I am a licensed Physical Therapist in USA with 8 years of professional experience.

As per my research interests, I am interested in fall prediction and prevention in Stroke and Parkinson's population using innovative interventions, Bio-engineering technologies, and machine learning models. In addition, I am also interested in balance and gait rehabilitation in Autistic Spectrum Disorders. My current research is focused on fall prediction and prevention in stroke patients using mechanistic/intervention studies and machine learning models.

In my free time, I like playing cricket, walking, driving, hiking and outdoor adventures.

David Johnson, BS

David is a PhD candidate in his third year at SLU. He is from the suburbs of Chicago and received his bachelor's degree in Biomolecular Engineering from Milwaukee School of Engineering. David is a member of Dr. Koyal Garg's Musculoskeletal Tissue Engineering lab that specializes in the research of Volumetric Muscle Loss injuries, common in military conflict and high impact motor collisions.

Day 2 Speakers

Wendy Weber, ND, PhD, MPH

Dr. Wendy Weber is the Branch Chief for the Clinical Research in Complementary and Integrative Health Branch in the Division of Extramural Research at the National Center for Complementary and Integrative Health (NCCIH) at NIH. She joined NCCIH as a program director in 2009. The Clinical Research Branch is responsible for the oversight of all NCCIH-supported clinical trials. Dr. Weber is the programmatic lead for the Trans-NIH Pragmatic Trials Collaboratory and the program officer for the Coordinating Center. She Co-Chairs the Translating Research to Practice for the Treatment of Opioid Addiction Team within the Helping End Addiction Long-Term (HEAL) Initiative, and oversees the Pragmatic and Implementation Studies for the Management of Pain (PRISM) Program. Dr. Weber is also a member of the planning and oversight team for the NIH-DoD-VA Pain Management Collaboratory and project scientist for its Coordinating Center. Dr. Weber serves on several Trans-Agency committees including serving as one of the NIH Representatives to the Leadership Council for the HHS Office of the Secretary Patient Centered Outcomes Research Trust Fund, and a member of the CMS-NIH Opioid Working Group and leads the subgroup on Evidence for Non-Pharmacological Treatments.

At NCCIH, Dr. Weber oversees a portfolio of pragmatic clinical trials, natural product clinical trials, studies of complementary medicine to promote healthy behavior, and multi-component complementary/integrative medicine intervention research. Her interests include the use of complementary medicine interventions for common pediatric conditions, mental health conditions, promoting healthy behaviors, and health services research.

Elizabeth Skidmore, PhD, OTR/L

Elizabeth Skidmore is an occupational therapist, Professor in the Department of Occupational Therapy, and Associate Dean for Research in the University of Pittsburgh School of Health and Rehabilitation Sciences. Her research seeks to optimize rehabilitation to promote long-term independence, community participation, and health among people with cognitive impairments after stroke and brain injury. She is currently conducting studies examining the effectiveness and implementation of strategy training in inpatient, outpatient, and community settings.

Stacey Dusing, PT, PhD

Dr. Stacey Dusing is the Sykes Family Chair of Pediatric Physical Therapy, Health and Development, Associate Professor and Director of Pediatric Research in the Division of Biokinesiology and Physical Therapy at the University of Southern California where she also directs the Motor Development Laboratory. She is a board certified pediatric physical therapy specialist and a Catherine Worthingham Fellow of the American Physical Therapy Association with over 25 years of clinical and research experience working with infants and children. Her research focuses on postural control, reaching, early exploration and interventions to advance development in infants with or at high risk of having developmental disabilities. Dr. Dusing is recognized around the world as a leader in the development of evidence based neonatal rehabilitation leading to collaborations in Australia, Brazil, and Norway. These collaborations support her mission to improving practice through innovative and evidence-based care in various health care environment.

Dr. Dusing's research has been funded by the National Institutes of Health, Maternal and Child Health Bureau, The US Department of Education, AD Williams Foundation, American Physical Therapy Association, Academy of Pediatric Physical Therapy, and the Foundation for Physical Therapy Research. She is currently the principal investigator of a multi-site clinical trial evaluating the efficacy and timing of intervention for infants born at less than 29 weeks of gestation. She is also the Co-Co-Principal Investigator of the NIH funded study of Sitting Together and Reaching to Play (START-Play) for children with Cerebral Palsy and was the site lead for the original START-Play trial. Her outstanding track record of research and mentoring were highlighted in the presentation of the Stephen Haley Outstanding Research Award in 2017 and the Knowledge Translation Lectureship in 2019 from the Academy of Pediatric Physical Therapy, and the 2022 Mentoring Award from the American Academy of Cerebral Palsy and Developmental Medicine. She will give the 28thJohn P Maley Lecture at the APTA Leadership Meeting in 2023.

Dr. Dusing received her BS in Physical Therapy from Daemen College in Buffalo NY. She earned her MS and PhD in Human Movement Science at The University of North Carolina at Chapel Hill and completed an NIH career development award at the University of Delaware. She is a graduate of the Leadership Education in Neurodevelopmental Disabilities (LEND) program. Dr. Dusing moved from Virginia Commonwealth University to the University of Southern California in 2020.

Christy Cassarly, PhD

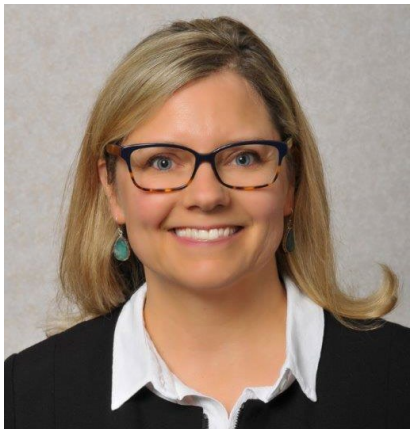
Dr. Christy Cassarly is an Assistant Professor of Biostatistics in the Department of Public Health Sciences at the Medical University of South Carolina (MUSC). As a biostatistician in the Data Coordination Unit (DCU), an academic statistical and data management center at MUSC, she has experience in the design, implementation, and analysis of multicenter clinical trials. Her research interests are in the area of statistical methodology with a focus on clinical trials.

Warren Lo, MD

Warren D. Lo, MD, is attending pediatric neurologist at Nationwide Children's and Clinical Professor of Pediatrics and Neurology at The Ohio State University College of Medicine. His clinical and research interests center on stroke in infants and children. This emphasis led to the development of the Stroke and Vascular Anomalies Clinic at Nationwide Children's, where he serves as director. His clinical research examines the social and cognitive impairments that result from stroke, and the improvement of recovery. Dr. Lo is named among the Best Doctors in America. Together with Dr. Roach and Dr. Heyer, Dr. Lo authored the book Pediatric Stroke and Cerebrovascular Disorders.

Michael Young, MD

Dr. Michael Young is a neurologist and neuroethicist at Massachusetts General Hospital, Harvard Medical School. He is the Associate Director of the MGH NeuroRecovery Clinic. After earning his MD from Harvard Medical School and MPhil in Philosophy from the University of Cambridge, Dr. Young completed Neurology residency and a Neurorecovery fellowship at Mass General Brigham and Spaulding Rehabilitation Hospital, specializing in longitudinal care of patients recovering from severe brain injuries and disorders of consciousness. His research is focused on improving care systems through neurotechnology, neuroethics and neuroscience, and as a member of the Lab for NeuroImaging of Coma and Consciousness, is devoted to clinical translation of neurotechnologies to detect, predict and improve recovery of consciousness and function in patients following brain injury. His research is supported by the NIH BRAIN Initiative and American Academy of Neurology.



Amy Darragh, OT, PhD

Dr. Amy Darragh is the Interim Director and Associate Dean of the School of Health and Rehabilitation Sciences at The Ohio State University. Dr. Darragh studies the effects of intensive rehabilitation on motor outcomes in infants and children with hemiplegia and the integration of families into clinical trial design and implementation. She leads the Pilot Studies Core for the National Pediatric Rehabilitation Resource Center (C-PROGRESS), which aims to improve pediatric rehabilitation infrastructure through pilot awards, mentoring, and outreach.

Devina Kumar, PhD, PT

Dr. Devina Kumar is a postdoctoral fellow at the Clinical Laboratory for Early Brain Injury Recovery at the Burke Neurological Institute in White Plain, New York. After receiving a PT degree in India, she completed her MSc in Neuro-muscular PT from the University of Pittsburgh. At the University of Delaware, her PhD work included the design and implementation of an 8-week intervention to improve motor function and cognition in adults with severe Traumatic Brain Injury. This concept was inspired from the Environmental Enrichment paradigms used in animal studies to study neural repair and rehabilitation. During the peak of COVID-19, her postdoctoral work has included testing an entirely virtual 3-month tele-exercise program for adults with chronic neurological impairments. Her research goals are centered on addressing the causal relationship between increased muscle tone and functional motor deficits in people with spasticity. She is currently leading a study to analyze soleus H-reflex operant conditioning on muscle tone, muscle strength and quality of life in adults with cerebral palsy.

Kelly Rishe, MSOT, OTR/L

Kelly Rishe, MSOT, OTR/L is a Clinical Research Occupational Therapist with the Massachusetts General Brigham Laboratory for Translational Neurorecovery and the Medical University of South Carolina Stroke Recovery Research Center. Kelly received her MS in Occupational Therapy from the Medical University of South Carolina in 2015 and her BS in Biological Sciences from Mississippi State University in 2013. Kelly also serves on adjunct faculty in the Divisions of Occupational Therapy at MUSC and Baylor University, as well as providing consultation on development of an upper extremity robotic as a Fellow in Bioengineering at Harvard University. She has expertise in telerehabilitation and upper extremity motor recovery after stroke.

Sangeetha Madhavan, PT, PhD

Sangeetha Madhavan is a Professor in the Department of Physical Therapy, and Director of the Brain Plasticity Laboratory at the University of Illinois at Chicago. Her research goals include developing individualized therapeutic approaches to advance existing neurorehabilitation practices using state-of-art technologies like transcranial magnetic stimulation (TMS), transcranial direct current stimulation (tDCS) and gamification. Specifically, she is investigating the effects of cortical priming on walking outcomes in stroke survivors using a high intensity interval treadmill training program (NIH R01HD075777). She is examining the feasibility of remotely supervised tDCS to slow disease progression in persons with ALS (NIH R21HD102722). She is interested in advancing telerehabilitation and is working on translating neuromodulation protocols into the patient's home via telehealth to broaden access to healthcare. Dr. Madhavan's research has been continually supported by NIH, AHA, NIDRR and others. Dr. Madhavan has published more than 70 peer-reviewed scientific manuscripts and peer-reviewed book chapters. Her role as an educator spans teaching, mentoring, and advising across the DPT, the MS, the PhD and undergraduate programs in Rehabilitation Science, Kinesiology, Medicine and Neuroscience.

James Guest, MD, PhD, FACS, FRCS

Dr. James Guest MD, Ph.D., FACS is a Professor of Neurological Surgery at the University of Miami and The Miami Project to Cure Paralysis. Dr. Guest performs translational and clinical research predominantly in spinal cord injury. He received Neurosurgical Board certification in Canada and the US and advanced training in spinal neurosurgery. His research focus is therapeutics translation, from pre-clinical through pivotal studies. Studies include drugs and biologics for neuroprotection and promotion of neuroplasticity as well as neuromodulation, rehabilitation, and combined therapeutics. He has received funding from NIH and the Department of Defense, for whom he serves as a Study section reviewer. He serves on the Grants Working Group of the California Institute of Regenerative Medicine and for the FDA to review biologics, cell, and gene therapy projects across a range of diseases. He is the co-Chair of the North American Clinical Trials Network. Dr. Guest has advised, lead, and participated in approximately 15 clinical trials in SCI.

Emma Beisheim-Ryan, PT, DPT, PhD

Emma Beisheim-Ryan is a physical therapist and Advanced Geriatrics Fellow at the University of Colorado Anschutz Medical Campus and Geriatric Research, Education, and Clinical Centers of the Eastern Colorado VA. Dr. Beisheim-Ryan's doctoral work focused on improving prosthetic prescription and evaluating and addressing post-amputation pain, and her clinical and research interests lie in improving function and quality-of-life for adults with chronic musculoskeletal conditions. As an Advanced Geriatrics Fellow, Dr. Beisheim-Ryan is currently training clinicians on best practices for implementing high-intensity interventions among older adults with medical complexities to improve rehabilitation standard-of-care.

Theresa Hayes Cruz, PhD

Theresa Hayes Cruz, Ph.D., is the director of NCMRR, which, through basic, translational, and clinical research, fosters the development of scientific knowledge needed to enhance the health, productivity, independence, and quality-of-life of people with physical disabilities.

As NCMRR director, Dr. Cruz led the development of the 2021 NIH Research Plan on Rehabilitation and planned the NIH-wide conference, "Rehabilitation Research 2020: Envisioning a Functional Future." She represents NIH on various federal committees, including the Interagency Committee on Disability Research.

In addition to her NCMRR duties, 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.

Session Moderators

Jennifer Stevens-Lapsley, PT, PhD, FAPTA

Dr. Stevens-Lapsley is a Professor and Director of the Rehabilitation Science PhD Program as well as the PT Section Director for Research and Development in the Physical Therapy Program at the University of Colorado Anschutz Medical Center. She is also the Associate Director for Research for the Geriatric Research Education and Clinical Center within the Eastern Colorado VA Healthcare System. She is focused on identifying, integrating, and advancing innovative evidence-based medicine solutions for older adult rehabilitation through highly effective research methods and partnerships. She has 20 years of clinical research experience, and her clinical research has resulted in over 150 publications, numerous awards, and over $20 million dollars to support her clinical research in the past 15 years.

Sharon Landesman Ramey, PhD

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 neurorehabiliaion. 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)

Linda Resnik, PT, PhD, FAPTA

Linda Resnik, PT, PhD, FAPTA is a Professor in the Department of Health Services, Policy and Practice, Brown University and a VA RR&D funded Research Career Scientist at the Providence VA Medical Center. Since, 2004, Dr. Resnik has worked to educate physical therapists on the importance of HSR and the methodologies for use in observational study designs and quality improvement and through publications and presentations at National meetings. She has led the Leadership and Administration core of the Center on Health Services Research and Training (CoHSTAR) since its inception in 2015. Dr Resnik also led a VA HSR&D funded initiative to develop a Guidebook for collaborative human subjects research activities across the VA and Department of Defense (DoD), and was first author of the

Guidebook and its revision bringing together a diverse group stakeholders from across government agencies to create a comprehensive Guide to research administration and conduct across complex environments.

Jill Heathcock, MPT, PhD

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.

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).

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 largescale 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.

Arun Jayaraman, PT, PhD

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.

Matthew Petrucci, PhD

Matthew Petrucci is the Scientific Program Manager for the Mobilize and Restore Centers at Stanford University. He obtained a MS in mechanical engineering and PhD in neuroscience from the University of Illinois at Urbana-Champaign, and a BS/BA in mechanical engineering from the University of San Diego. He is interested in combining biomechanical and neurophysiological tools to restore or rehabilitate human mobility and performance. His previous research has focused on cross-sectional, longitudinal, translational, and feasibility studies in people with Parkinson's disease, people with multiple sclerosis, and firefighters. These studies included evaluating objective biomarkers of disease or performance, optimizing, and evaluating novel treatments and interventions, developing real-time closed-loop algorithms, and clinical trials.

Zev Rymer, MD, PhD

W. Zev Rymer, M.D., Ph.D., has lent his expertise and leadership first to the Rehabilitation Institute of Chicago (RIC) and then to Shirley Ryan AbilityLab for the last quarter century. He was the second scientist hired by the organization and is a founding force behind the growth and success of our research enterprise, to date the largest and most internationally revered of its kind. He served RIC as Chief Scientist for nine years, transitioning to his current role as Director of Research Planning in July 2014. Today he also continues to lead his renowned Sensory Motor Performance Program (SMPP) laboratories. In addition, Dr. Rymer served as RIC's John G. Searle Chair in Rehabilitation Research, stepping down in July 2014.

In addition to his research roles, Dr. Rymer holds appointments as Professor of Physical Medicine & Rehabilitation, Physiology and Biomedical Engineering at Northwestern University and at the Edward Hines, Jr., Veterans Administration Hines Hospital, Hines, Illinois. His laboratory receives support from the National Institutes of Health (NIH), the Department of Education's National Institute on Disability and Rehabilitation Research (NIDRR), a number of research-oriented foundations and the U.S. Department of Veterans Affairs.

MR3 Network Action Steps for Diversity, Equity, and Inclusion

- 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.

For More Information, Visit
ncmrr.org/diversity

Day 1 Abstracts

Topic 1: Novel Trial Design

Distinctive Challenges in Design and Data Analysis of Pediatric Rehabilitation Trials

Sharon Ramey[1], Stephanie DeLuca[1], Mark Conaway[2], Amy Darragh[3], Warren Lo[3], Jill Heathcock[3], Craig Ramey[1]
[1]Virginia Tech, [2]The University of Virginia, [3]The Ohio State University

Rehabilitation science builds on both theory and empirical evidence from case histories, pilot studies, and basic research. There are many important issues for determining success of a pediatric clinical trial including how to determine what is clinically and personally 'meaningful change'. The leadership team of investigators at C-PROGRESS have worked collaboratively on 5 multi-site randomized clinical trials, including an ongoing Phase 3 RCT. Using an interactive symposium format, we will outline key issues in studying treatment efficacy and effectiveness in pediatric populations. These include: issues of disaggregating chronological age and maturation from treat-induced changes; lack of continuity/isomorphism in outcome measures across ages; well-documented multi-domain changes beyond targeted primary outcomes; high levels of intra- and inter-subject variability (impacting precision of measurement and power in clinical trials); determining 'clinical significance' or meaningful clinical changes; role of parent or child subjective reports; and complexity of healthcare issues and combined treatments; understanding multiple endpoints; determining composite(profile) outcomes in treatment-induced changes; and cross-study comparisons. A new issue in current pediatric trials concerns both equipoise and the changing landscape of 'usual and customary' care for particular clinical populations. We will focus on proposed solutions and invite active exchange of information with conference participants. Based on participant interest and contributions, we will produce a set of references and offer individualized follow-up for those currently engaged in pediatric clinical trials through C-PROGRESS supports.

We Found a Way: Conducting and Modifying an In-person Randomized Controlled Trial for Vestibular Disorders During the COVID-19 Pandemic in New York City

Anat Lubetzky[1], Daphna Harel[1], Santosh Krishnamoorthy[2,3], Gene Fu[2,3], Brittani Morris[1], Maura Cosetti[3], Jennifer Kelly[2,3]
[1]New York University, [2]New York Eye and Ear Infirmary of Mount Sinal, [3]Icahn School of Medicine at Mount Sinal

We created a clinical virtual reality application for a Head Mounted Display to provide contextual sensory integration (C.S.I.) for patients with vestibular dysfunction in a functional and non-threatening context. We began a pilot randomized controlled trial in Fall 2019 to compare C.S.I. training to traditional vestibular rehabilitation. The study was designed as a collaboration between a university research lab (for assessments) and hospital clinic (for both interventions). The protocol included 2 pre assessments, 8 intervention sessions over 8 weeks and 1 post assessment. We recruited 9 patients pre pandemic. Two completed (1 traditional, 1 app), 1 dropped out (traditional) and 6 had to stop because the study shut down in March 2020. In-person research was paused for 6 months at our hospital and most of our clinical team was deployed to treat covid patients. In September 2020 the hospital allowed for in-person research to resume while the university research lab was still closed. We decided to adapt the original protocol to the new circumstances. The trial was completed in April 2022. We were able to recruit 20 additional patients. There were no differences between patients pre and post covid, no difference between patients who dropped out or completed and no difference between group in attrition %. In addition to the trial results, in this presentation we will discuss all trial's modifications including changes in baseline and post assessments from lab to clinic, changes in blinding of

assessors, allowing breaks in the protocol when patients needed to quarantine etc.

Application of Hybrid Effectiveness-Implementation Designs to Bridge the Research-Practice Divide for mRehab Interventions

Susan Magasi[1], Zhengjia Chen[1], Rachel F. Adler[2], David Victorson[3]
[1]University of Illinois at Chicago, [2]Northwestern Illinois University, [3]Northwestern University

Mobile rehabilitation (mRehab) interventions hold great potential to close the access gap in much needed rehabilitation medicine services, yet organizational, clinical, and consumer barriers to implementation persist. Given the pace of technological innovation, there is a critical need to bridge the divide between mRehab interventions created by researchers and those in which patients and professionals are using in practice. The traditional research pipeline that encourages a staged approach to moving an intervention from efficacy trials to the real world can take a long time. To address this issue, hybrid effectiveness-implementation designs were developed to promote the intentional examination of effectiveness and implementation outcomes within a single study. This presentation will explore the range of hybrid designs available to rehabilitation researchers with illustrative mRehabilitation exemplars. There are three types of hybrid designs, all of which vary in their primary focus and relative emphasis on effectiveness versus implementation outcomes. A type 1 hybrid focuses primarily on the effectiveness outcomes of an intervention while exploring its "implementability." A type 2 hybrid design has a dual focus on effectiveness and implementation outcomes by allowing for the simultaneous testing or piloting of implementation strategies during an effectiveness trial. Finally, a type 3 hybrid design focuses primarily on implementation outcomes while also collecting effectiveness outcomes related to the intervention's uptake or fidelity. Hybrid effectiveness-implementation designs may help realize the democratizing potential of mRehab by getting evidence-based interventions into the hands of the people who can most benefit from them when they need them most.

Topic 2: Barriers and Difficulty of Success

Standardization to Achieve Optimal Data Quality in Multi-Site Rehabilitation Clinical Trials

Veronica T. Rowe[1], Christy Cassarly[2], Wayne Feng[3], Gottfried Schlaug[4], Pratik Chhatbar[3], Caitlyn Meinzer[2], Joseph Broderick[5], Scott Janis[6], Jean-Christopher Arnaud[2], Wenle Zhao[2], Estate Sokhadze[3], Maxwell Mays[5], Anant Shinde[4], Stacy Fritz[7], Steven Wolf[8]
[1]Georgia State University, [2]Medical University of South Carolina, [3]Duke University, [4]UMCMS-Baystate, [5]University of Cincinnati, [6]National Institute of Neurological Disorders and Stroke, [7]University of South Carolina, [8]Emory University

While the standardization of a clinical trial protocol, investigational treatment, and data collection procedures are important in all clinical trials, unique challenges emerge in the implementation of large-scale multi-site rehabilitation clinical trials. TRANScranial direct current stimulation for Post-stroke mOtor Recovery (TRANSPORT2) is an ongoing phase II multi-site clinical trial (NCT03826030) with the primary goal of determining whether there is an initial overall treatment effect in three dosing groups: sham tDCS + modified Constraint-Induced Movement Therapy (mCIMT), 2 mA tDCS + mCIMT, and 4 mA tDCS + mCIMT. The TRANSPORT2 investigators have implemented a number of protocol standardization and quality of control strategies with the

goal of minimizing errors in protocol execution, therapy administration, and outcome collection and interpretation at the 12 clinical sites participating in the trial. These strategies include:
-A research training study in which each site enrolls training participates in order to standardize mCIMT, outcome assessments, and tDCS prior to enrolling subjects into the TRANSPORT2 trial
-Ongoing demonstration of fidelity of treatment and evaluation to the central cores after every fourth subject is enrolled at a particular site
-Centrally collected and scored primary outcome measure (Fugl Meyer - Upper Extremity)
-Centrally collected and analyzed exploratory outcome measures (TMS and MRI)
These standardization strategies, and lessons learned through implementation, will be discussed.

Multi-Site Clinical Trials: Treatment Fidelity and Beyond

Noelle G. Moreau[1], Kristie Bjornson[2]
[1]Louisiana State University Health Sciences Center, [2]Seattle Children's Research Institute

Multi-site clinical trials are becoming more and more prevalent in rehabilitation research as a way to improve diversity, increase recruitment numbers, and improve generalizability, among others. In this talk, the authors will draw on their experiences from conducting multi-site rehabilitation clinical trials and discuss the intersections between fidelity, rigor, and reproducibility. Treatment fidelity and assessment or outcomes fidelity are both important components of conducting a successful clinical trial. When interpreting the results of a clinical trial, it is important to examine the treatment fidelity to uncover the extent to which the participants received the intended dosage for the intervention. The 5 domains of fidelity (study design, training, delivery, receipt, and enactment) will be discussed with an emphasis on training, delivery, and receipt. Further, the importance of documenting the intervention-specific fidelity measures beyond a single metric, such as attendance, will be emphasized. An example from a resistance training intervention will be provided in order to illustrate the adequate documentation and reporting of the delivery of all key dosing parameters (frequency, duration, volume, intensity, and velocity of movement) and the receipt based on progressions in training load/intensity. A successful secondary analysis can then determine which parameters were the key ingredients associated with improved outcomes. Treatment fidelity will be expanded to include individualized dosing and progression to account for subject heterogeneity. Examples of successful decision-tree algorithms for progression based on individualized subject responses from two on-going multi-site clinical trials will be shared with the audience.

Participant Retention, Compensation, and Compliance during Knee Joint Immobilization Research: An Analysis of Two Clinical Trials

Matt Stock[1], Rob MacLennan[2], Ryan Girts[3], Kylie Harmon[4], Jeanette Garcia[1]
[1]University of Central Florida, [2]Oklahoma State University, [3]Pfeiffer University, [4]Syracuse University

Investigators studying muscle disuse often rely on joint immobilization models because they provide excellent internal validity. However, asking healthy adults to place a limb in a brace or cast and refrain from weightbearing to induce weakness presents unique challenges. Our laboratory has completed two knee immobilization clinical trials to study neuromuscular plasticity. Methods: In Study 1 (2017-2018), we recruited females for a two-week immobilization study. Laboratory testing was conducted 48 and 72 hours, as well as one and two weeks, following immobilization. Compensation for completing Study 1 was $350 (Visa/Mastercard). In Study 2 (2021-2022), we recruited males and females for a one-week study that featured neural and muscular interventions, as

well as a post-immobilization rehabilitation program. Compensation for completing Study 2 was ≤ $220 (Amazon) and a t-shirt. In both studies, compliance was monitored via accelerometers. A researcher was responsible for checking in with participants via daily phone calls and/or text messages. Results: Twenty-six females enrolled in Study 1, but 11 withdrew (57.7% completion). Reasons for withdrawing included study duration, medication changes, difficulty accomplishing daily activities, and brace discomfort. Fifty participants enrolled in Study 2 (28 males, 22 females), but five males and three females withdrew (84% completion). Reasons for withdrawing from Study 2 only included discomfort with laboratory tests (electrical stimulation and transcranial magnetic stimulation) and scheduling conflicts. Conclusion: Study duration has a substantial impact on completion rates of knee immobilization studies. We recommend ≤ one-week studies, fostering a supportive environment for participants, and providing ~$200/week compensation and t-shirts.

Topic 3: Outcomes

A Story of Those Who Get Left Behind

Ela B. Plow[1], M Widina[1], A Mohan[1], X Li[1], K O'Laughlin[1], J Liu[1], E Barden[1], T Bennett Robinson[1], Gregory Nemunaitis[1], Francois Bethoux[1], Ken Uchino[1], Xiaofeng Wang[1], Gail Forrest[2], S Kirshblum[2], Svetlana Pundik[3], Kristi M Henzel[3], Mary Ann Richmond[3], Kelsey Baker[4], Anne Bryden[5], DA Cunningham[5], JS Knutson[5]
[1]Cleveland Clinic Foundation, [2]Kessler Institute of Rehabilitation, [3]Louis Stokes Cleveland VA Medical Center, [4]University of Texas, [5]MetroHealth Center for Rehabilitation Research

There is a tremendous burden of severe UE paresis after stroke and spinal cord injury (SCI). Persons with severe paresis are typically excluded from RCTs because interventions cannot be made feasible for them, and outcome assessments are not designed to accommodate significant impairment. Unfortunately, this perpetuates the (vicious) cycle of disability- because persons with severe paresis are excluded, what works and does not work for them cannot be determined. Here we offer a window into challenges and successes of studying patients with severe paresis from ongoing single- and multi-site RCTs in stroke and cervical SCI (NIHR01HD098073, SCIRPW81XWH1810530) to develop a roadmap for future. Topics will include: 1) scientific challenges in identifying treatments specific to mechanisms of and feasible to administer among persons with severe paresis; 2) delivery of rehabilitation tailored in content and length to meet unique challenges posed by severe paresis; 3) outcomes assessments guided by their ability to identify impairments/limitations in the presence of severe weakness, feasibility to administer without exaggerating fatigue/burden, and sensitivity to capture small, albeit meaningful, effects; 4) patient expectations, where in the absence of distal improvements statistically significant gains seem meaningless and clinically-meaningful gains calibrated to severity are unknown; 5) co-morbidities and worsening effects of chief diagnoses; 6) familial/personal burden worsened dramatically for those with severe paresis and 7) logistics of travel and caregiver availability that ensure gainful participation. A dedicated and long-standing commitment to evaluate treatments in this disadvantaged population is necessary to overcome one of the most complex challenges facing rehabilitation research.

Beyond the Clinic: Measuring Walking Performance and Mobility in Daily Life

Kristie Bjornson[1,2], Phil Hurvitz[3], Noelle Moreau[4]
[1]Seattle Children's Research Institute, [2]University of Washington, [3]Urban Farm Lab, [4]Louisiana State University

Walking activity is known to be predictive of participation in mobility, education, and social relations for children with cerebral palsy (CP) per cohort and population-based studies. Traditionally, clinic or laboratory-based

outcome measures of walking activity have been implemented to measure the effectiveness of rehabilitation interventions to optimize walking and community mobility. However, these outcomes do not provide knowledge of translation or carryover to walking in natural settings. Synchronizing accelerometry data with global positioning system (GPS) data allows the combined measurement of temporally explicit stride counts and rates with the precise location of the walking activity. This novel approach represents a unique departure from the status quo by using wearable sensors to directly measure walking and mobility-based participation in the real-world (e.g., home, school, park). Community walking activity levels and intensity of children with CP relative to a typically developing cohort will be presented. We will describe a process for synchronizing accelerometry-based walking and GPS-based location information by matched time stamps. This temporally and spatially precise walking information will be reported as an outcome of interventions to enhance walking (i.e., orthotics, home-based treadmill training) in children with CP through exemplar group and individual research data (i.e., daily Google Map). The novel combination of sensor and monitoring technology has potential to inform the documentation of rehabilitation strategy effectiveness in the context of daily life.

OpenCap: 3D Human Movement Dynamics from Smartphone Video

Antoine Falisse[1]*, Scott Uhlrich[1]*, Lukasz Kidzinski[1]*, Julie Muccini[1], Michael Ko[1], Akshay Chaudhari[1], Jennifer Hicks[1], Scott Delp[1] (**Authors contributed equally*)
[1]*Stanford University*

Measures of human movement dynamics, such as loading of bones and muscles, are sensitive biomarkers of neurological and musculoskeletal disease status and progression. However, movement dynamics are rarely quantified in large-scale clinical trials due to the prohibitive cost, time, and expertise required to make these measurements in a motion capture laboratory. Instead, functional endpoints for clinical trials typically comprise general movement evaluations that are evaluated visually or with a stopwatch. The lack of fast, precise, and repeatable functional biomarkers limits the statistical power of outcomes. To address these limitations, we developed OpenCap, an open-source platform for evaluating movement dynamics in minutes using two smartphones. OpenCap's web application enables users to collect synchronous videos and visualize movement data that is automatically processed in the cloud, thereby eliminating the need for specialized hardware, software, and expertise. Through a validation study comparing OpenCap to gold-standard laboratory techniques, we show that OpenCap estimates muscle activations, joint loads, and joint moments with sufficient accuracy to inform research and clinical decisions for applications including osteoarthritis, age-related muscle weakness, and post-surgical functional recovery. Additionally, we demonstrate OpenCap's practical utility through a field study in which a clinician estimated movement dynamics of 100 individuals in real-world settings for about 300 times less money and in about 25 times less time than was previously possible. By reducing the barriers to evaluating human movement dynamics, OpenCap facilitates the development of more sensitive functional endpoints for rehabilitation clinical trials and the incorporation of these measures into clinical practice.

"Student" Session: Idea Blitz!

Utilization of EPIC Slicer Dicer in Achilles Tendinopathy - A Recruitment Case Study

Vaibhavi Rathod, Smita Rao

The use of electronic health record (EHR) tools such as Slicer Dicer has substantial potential to improve clinical trials planning. Even though musculoskeletal diseases account for more than 50% of disabling health conditions,

there is limited literature exploring the use of these tools in musculoskeletal rehabilitation. The purpose of this study is to examine potential utility of using Slicer Dicer for cohort exploration in Achilles Tendinopathy (AT). Methods: Using EPIC, we searched over 350 sites affiliated with NYU Langone Health using ICD-10-based diagnoses. Results were sliced by year, provider, age, race, comorbid conditions. Results: Over a 12 month period (2021-present), 6310 patients were diagnosed with AT. Number of patients dropped to 5347 in 2020 due to the COVID-19 pandemic, but prior to that the number of patients had risen from 662 in 2010 to 5458 in 2019. 78.5% were within 18-70 years, 18.28% were >70 years. First encounter ranked by provider department indicated that 53.4% presented to internal medicine and 15.2% presented to orthopedic surgery. 59.6% were white, 11.3% were African American and 0.03% were Asian. 30% of patients had primary hypertension, 25% had hyperlipidemia, 14% had osteoarthritis, 10.2% had Type 2 Diabetes Mellitus. Conclusion: At our academic medical center, the number of AT diagnoses has steadily increased, keeping with the growth in ambulatory care sites. Slicer Dicer is a powerful tool for cohort exploration with significant potential to reduce recruitment bias by allowing for recruitment across multiple geographic locations and providers.

Changes in the Fronto-central Brain activity for Balance Control in Chronic Stroke Survivors

Komal Kukkar, Nishant Rao, Sheel Shah, Diana Huynh, Jose Contreras-Vidal, Pranav Parikh

Nearly 50% of stroke survivors experience a fall within 6-12 months after discharge from hospital, which leads to significant complications and financial burden on the society. Balance control is a key indicator of mobility and independence in ADLs, and its impairment is an important factor contributing to falls in stroke patients. Therefore, it is important to understand the mechanisms underlying impaired balance control following stroke. Remarkably, the contribution of cortical reorganization following stroke to impaired balance control remains unknown. In this study, we investigated the changes in activation over balance related brain areas in individuals with chronic stroke. We have recruited 7 stroke patients with mild-to-moderate severity and 4 age/gender matched healthy adults. Clinical assessment was performed using Berg Balance Scale and Time Up and Go tests. Participants performed a standing balance task in presence of balance perturbations with simultaneous neuroimaging using electroencephalography (EEG). On the clinical tests and the laboratory-based balance task, stroke patients showed poor performance when compared with healthy controls. Our preliminary EEG findings suggest differences in Delta and Theta band EEG power over the frontocentral region between patients and healthy controls during the balance task. These findings suggest changes in the activation within frontocentral brain areas during a balance task following stroke. Ongoing work is investigating the changes in functional coupling between the frontocentral activity and lower limb muscle activity during the balance task in stroke patients. These results will aid in the identification of targets for neurorehabilitation of balance control in stroke patients.

Regenerative Rehabilitation for Enhancing Muscle Recovery Following Volumetric Muscle Loss

David Johnson[1], Jeffrey Au[1], Connor Tobo[1], Aakash Nagarapu[1], Natalia Ziemkiewicz[1], Hannah Chauvin[1], Allison Paoli[1], Charles West[1], Colin Flaveny[1], Koyal Garg[1]
[1]*Saint Louis University*

Volumetric muscle loss (VML) injury causes irreversible deficits in muscle mass and function and often results in permanent disability. The current standard of care is physical therapy but it is limited in mitigating functional

deficits. We have previously optimized a rehabilitation technique using electrically stimulated eccentric contraction training (EST) that improved muscle mass, strength, and size in VML injured rats. A biosponge scaffold composed of extracellular matrix proteins has previously enhanced muscle function post-VML. This study aimed to determine whether combined application of a regenerative therapy (i.e., biosponge) with a novel rehabilitation technique (i.e., EST) could enhance muscle mass and strength recovery in a rat model of VML. A VML defect was created by removing ~20% muscle mass from the tibialis anterior muscle in adult male Lewis rats. Experimental groups included VML injured rats treated with biosponge+EST or biosponge alone (n=6). EST was implemented 2 weeks post-injury and was continued for 4 weeks. A repeat-bout effect was observed with a linear increase in eccentric torque over 4 weeks. The combined application of biosponge+EST improved muscle mass by ~10% (NS) and peak isometric torque by ~52% (p=0.0411) compared to biosponge treatment alone at 6 weeks post-injury. Qualitative and quantitative analysis of muscle cross-sections also suggests improvements in muscle structure; specifically in mean cross-sectional area of fast twitch (Type 2B) myofibers. Thus far, these findings show the potential for a combined regenerative and rehabilitative therapy to improve muscle recovery following VML. Ongoing work will determine the extent of immunomodulation, angiogenesis, regeneration and fibrosis through additional histology and gene expression analysis.

Day 2 Abstracts

Topic 4: Novel Trial Design

Assessing Organizational and Provider Context and Readiness to Inform National, Multi-site Pragmatic Trials: Methods and Lessons Learned

Elizabeth Skidmore[1], Alexandra Harper[1], Jennifer Stevens-Lapsley[2], Scott Bleakley[3], Cheryl Miller[4]
[1]University of Pittsburgh, [2]University of Colorado, [3]UPMC, [4]Encompass Health

Implementation of standardized, evidence-based interventions in rehabilitation settings requires a careful examination of organizational and provider context and readiness. Guided by the Consolidated Framework for Implementation Research, we conducted a two-phase cross-sectional descriptive study, in partnership with a large for-profit national rehabilitation corporation. In phase I, we characterized variations among 139 inpatient rehabilitation facilities with respect to geographic region, size, organizational structure, staffing, operations, and clientele using a combination of surveys and electronic health record information. Our team of scientists, corporate leaders, rehabilitation providers, and patient advocates then used nominal group technique to select 30 facilities with sufficient variation in region, size, and clientele to participate in phase II, oversampling facilities serving high proportions of patients from historically marginalized race and ethnicity groups. In Phase II, we recruited the director of therapy operations and six rehabilitation providers (i.e., occupational, physical, and speech therapy) from each of the 30 facilities to examine readiness for intervention implementation using convergent mixed methods. Participants completed validated surveys assessing attitudes and behaviors related to evidence-based practice as well as organizational culture, implementation climate, and readiness for change. Participants then engaged in focus groups to discuss barriers and facilitators to implementation of an efficacious intervention that shows promise for reducing disability among people with cognitive impairments in this setting. Using the findings and the Expert Recommendations for Implementing Change Strategy Matching Tool we identified a core set of implementation strategies to be examined in a future hybrid I effectiveness-implementation pragmatic trial.

Moving Infant Rehabilitation Forward Through Rigorous Research Design: Moving from Single Site Single Variable Trials to Multi-arm, Multi-phase Intervention

Stacey Dusing, Jen Burnsed, Richard Stevenson, Sharon Brown, Mary Shall, SPEEDI Clinical Trial Team, STEPS2_Home Consortium

Advances in life saving procedures for infant born preterm, international guidelines on early detection of cerebral palsy and US federal education policy all support the need to start intervention to prevent or ameliorate disability early. However, intervention is often delayed months or years due to complicated policy, lack of access, and limited information on why early matters. Combined with a lack of efficacy data from large scale efficacy trials pediatric and infant rehabilitation is being left behind. We are not generating research fast enough to serve our youngest clients in need of habilitation services. Clinical trials that have been completed are often years away from effectiveness or implementation research due to the need for further testing of dose, timing, or other parameters. This presentation will highlight the use of a 3 arm clinical trial to address the question of efficacy and timing of intervention for infants born very preterm during the transition from NICU to Home. The speaker will pose important questions on how the field of rehabilitation can move forward. A comparison of the pros and cons of multiple serial clinical trials prior to implementation vs. multi-arm, multi-phase interventions trial will support the need for alternative designed. While testing multiple factors in a single study designs may require larger samples and will cost more per study, they are needed to move the field toward implementation of effective rehabilitation or habilitation.

Responder Analysis vs. Mean Change Analysis in Stroke Rehabilitation Clinical Trials

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Planning stroke recovery clinical trials requires nontrivial consideration of the most appropriate design to determine whether or not a clinically meaningful treatment effect exists. The stroke recovery community often focuses on mean changes on a continuous outcome, for example the Fugl Meyer - Upper Extremity (FM-UE), to measure treatment effect. Responder analysis, in which a continuous or ordinal outcome is dichotomized to define "responders" and "non-responders", has emerged as an alternative to assess clinical relevance. In responder analysis, the definition of responder can be consistent for all subjects or baseline severity can be incorporated. By using a so called "sliding dichotomy", the definition of responder varies according to baseline severity which may be desirable if criterion for success differs by prognosis. Responder analysis may be favored by clinicians as it can be more straightforward for individual patients to interpret and understand the risk and benefit of treatment. While this approach has gained popularity amongst clinicians, it has been criticized by statisticians largely due to cost in efficiency. The benefits and pitfalls of responder analysis will be discussed.

Topic 5: Ethics and Diversity

Recruiting Under-Represented Minorities (U-RM) for Rehabilitation Research

Warren Lo[1,2], Amy Darragh[1], Stephanie DeLuca[3], Jill Heathcock[1], Craig Ramey[3,4], Sharon Ramey[3,4]
[1]The Ohio State University, [2]Nationwide Children's Hospital, [3]Virginia Tech, [4]Fralin Biomedical Research Institute

Background: There is a long history of inequity in recruiting U-RM to clinical trials. Addressing Diversity, Equity, and Inclusion (DEI) is now an expectation of funding agencies and scientific journals, so rehabilitation researchers must prepare to address DEI when proposing trials. Challenges: NIH Research, Condition, Disease Categorization (RCDC) Inclusion Reports from 2018 suggest that in pediatric clinical trials funded by NINDS only 6% of children were Latinx and only 4% were Black, far below population averages for children ages 0-18 yrs. U-RM recruiting in two on-going stroke rehabilitation trials will be reviewed to illustrate experiences with recruitment. Approaches: Short-term steps include educating and engaging U-RM community healthcare providers and community leaders about the intended trial; gathering U-RM community input during trial design regarding logistical challenges (transportation, financial support to overcome barriers); budgeting resources to overcome logistical challenges; academic centers can work with CTSA resources to increase U-RM recruitment; regularly update trial sites with U-RM recruiting targets. Long-term steps: train and recruit more minority clinical researchers to increase U-RM representation in research staff and investigators; educate reviewers about steps needed to assure DEI; develop long-term relationships with community leaders to explain the importance of clinical research for their communities. Summary: Increasing recruitment of U-RM requires short-term and long-term approaches to educate the referring community, develop trust and understanding in U-RM groups. In a multi-site trial local commitment to minority recruitment can vary so sites need to be constantly reminded of importance of U-RM recruitment.

Ethical Considerations in Neurorehabilitation Clinical Trials: Emerging Principles & Priorities

Michael Young[1]
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As the rehabilitation clinical trial landscape for patients with brain injuries and other neurological disorders expands, consideration of associated ethical dimensions is of mounting importance. Here I assess central ethical considerations in rehabilitation clinical trials involving participants with neurological disorders, including (1) autonomy, respect for persons and informed consent of individuals with neurological disorders; (2) balancing unknown benefits and risks in the especially sensitive context of novel neurointerventions to promote rehabilitation (3) disclosure to surrogates and clinical teams of investigational results pertaining to recovery and neuroprognosis; (4) justice and equity considerations, including fair access to rehabilitation clinical trial enrollment across patient communities and backgrounds; (5) post-trial responsibilities and data handling. Guiding principles and research opportunities for rehabilitation clinicians, researchers, ethicists, and other scholars engaged in rehabilitation clinical trials are described to advance ethical study design and deployment in this uniquely complex yet vital area of study.

Stakeholder Engagement and Integration in Clinical Trials

Amy Darragh[1], Mara Yale[2], Sharon Ramey[3], Craig Ramey[3], Warren Lo[1,4], Stephanie DeLuca[3], Jill Heathcock[1], Jenny Murray[2]

[1]The Ohio State University; [2]I-ACQUIRE Parent Council; [3]Fralin Biomedical Research Institute, Virginia Tech; [4]Nationwide Children's Hospital

Clinical trials in rehabilitation present unique challenges and opportunities with interventions that are often complex and time-intensive. Researchers must collaborate with prospective participants, families, and caregivers to recruit, accrue, and retain study participants. When a study team includes both researchers and participant stakeholders as integral members, vital and prolonged partnerships form that ensure participant-centered research processes and outcomes and enrich the research experience for all parties. The C-PROGRESS leadership team has engaged with families in multiple pediatric clinical trials, culminating in the integration of a Parent Advisory Council in an ongoing multisite, phase 3 randomized controlled trial. In an interactive, discussion-based session, our team of parents and scientists will describe the distinct advantages and common challenges when integrating a parent advisory council into trial design and implementation. Topics include: timeline (e.g. at which research stage to initiate stakeholders-scientist partnership), roles and responsibilities (e.g. consent & enrollment; recruitment; training), communication (e.g. participation in executive steering committee; investigator liaisons), scientific integrity (e.g. bias, equipoise), parent-reported and family-centric outcomes (e.g. family feedback and family input into relevant and meaningful outcomes), and family-centered procedures (e.g. respectful communication; sensitivity to family needs and experiences). In addition, we will share recommendations based on experience with integrating stakeholder councils into grant submissions, structuring the council, establishing and funding council payments, designing systems of communication and feedback, and navigating regulatory and compliance issues. Following the session, individuals interested in further information can access C-PROGRESS investigators for consultation about integrating stakeholder advisory groups into their clinical trials.

Topic 6: Telerehabilitation

Overcoming Barriers During COVID-19: A Completely Virtual Tele-Exercise Intervention Study for Adults with Chronic Neurological Impairments

Devina Kumar, Amy Bialek, Ayushi Devicha, Lydia E. J. Currie, Rachel Garn, Talita Campos, Kathleen Friel

Exercise is a critical component of a healthy lifestyle, yet many with chronic neurological impairments (CNI) do not regularly exercise. Reasons include inaccessibility of gyms and equipment, transportation, and costs. COVID-19 magnified these barriers. Study goal: to feasibly provide seated, home-based exercise to people with CNI using a completely virtual study design. Participants were screened and consented over Zoom. Intervention: 12-week, 3x/week seated exercise program. One group (synchronous, n=33) attended classes at a specified time, on Zoom with instructor and classmates. Classes were recorded. The other group (asynchronous, n=30) was given recorded videos to complete on their own time. Participants were mailed a blood pressure (BP) monitor and Polar OH1 heart rate (HR) recording device that synched to a smartphone app. The study team downloaded HR data from the Polar website. Before and after each class, participants completed surveys on REDCap that queried pain level, BP, exertion, motivation, and satisfaction. Before the first session, midpoint, after the last session, and one month later, participants completed a Reasons for Exercise Inventory, Physical Activity Log, Perceived Wellness Survey, Physical Activity Enjoyment Scale (PACES), and SF-36v2, on REDCap virtually. Participants reported satisfaction with the study. Percent of participants satisfied or extremely satisfied with:

use of OH1 (90%), use of Zoom (84%), ease of surveys online (97%), indicating strong feasibility of the protocol. Both groups improved in PACES (p=0.02), which is a measure of physical activity enjoyment. These findings demonstrate that virtual study designs can be feasible and enjoyable for people with CNI.

Novel Clinical Trial of Portable Near-Infrared Spectroscopy-based (fNIRS) Brain Computer Interface to Augment Upper Extremity Motor Recovery after Stroke

Kelly Rishe, Taya Hamilton, Sydney McKiernan, Julie DiCarlo, Tony Ingram, Chris Friesen, Erin Meier, Michael Young, David Lin

Post-stroke rehabilitation has been shown to be beneficial in helping to restore stroke survivors' movement abilities and improve their level of function. Rehabilitation practice is increasingly in need of more quantifiable and real-time measures of therapeutic interventions to optimize treatment approaches and facilitate motor recovery processes. However, most technologies capable of producing neural biomarkers are currently limited to the laboratory due to size, cost and complexity of operation (e.g., functional magnetic resonance imaging). There is indeed increasing evidence that high dose, individualized, engaging therapy maximizes motor recovery. However, stroke survivors often do not receive adequate rehabilitation services due to challenges including transportation and financial burden-issues exacerbated in rural areas where access to specialized outpatient rehabilitation may be inadequate or non-existent. Solutions to post-stroke rehabilitation that incorporate portable neurophysiological measurement technologies and telehealth strategies to maximize practice are critically needed to facilitate best possible motor recovery. Here we describe a novel pilot clinical trial of telerehabilitation paired with a portable near-infrared spectroscopy (fNIRS) biofeedback system for at-home upper extremity motor rehabilitation following stroke. Our rehabilitation intervention provides a combination of asynchronous app-based exercise sessions guided by fNIRS-generated neural biomarker data and synchronous therapist-led telerehabilitation sessions. We discuss the rationale and design of our clinical trial, how fNIRS signals are integrated for participants and therapists, and selection of our study outcome measures. We describe experiences with the first cohort of participants in this ongoing study, and highlight early lessons learned in designing and deploying this novel clinical trial.

Innovative Telerehabilitation Model for Slowing Disease Progression in Amyotrophic Lateral Sclerosis (ALS) Using Non-invasive Brain Stimulation

Sangeetha Madhavan[1]
[1] *University of Illinois at Chicago*

Innovative telerehabilitation model for slowing disease progression in amyotrophic lateral sclerosis (ALS) using non-invasive brain stimulation ALS is the third most common adult-onset neurodegenerative disease with no known cause or cure. Current treatment is based primarily on symptom management and palliative care, making rehabilitation an integral part of clinical management. Although symptom management has improved in the recent years, there is lack of evidence-based clinically meaningful therapies. Recent advances in ALS research have reinforced the pathology of ALS as primarily a disease of the cerebral cortex. We proposed a novel approach that targets hypoexcitable cortical circuits using remotely supervised non-invasive facilitatory transcranial direct current stimulation (tDCS). Telerehabilitation is a relatively new approach to broaden access to rehabilitation services in a cost-effective manner, particularly for those with limited mobility and transportation barriers. In this symposium, we will present our NIH-funded clinical trial protocol to determine safety and feasibility of long-term treatment (6-months, 3 times/week) with remotely supervised tDCS in

persons with ALS. We will outline procedures for training staff and patients in tDCS administration and remote supervision, actively monitoring patient safety, and share barriers and opportunities to participation in telerehabilitation research for persons living with neurodegenerative conditions. Pilot data from 5 participants enrolled in the study will be presented. The current study is the first to examine remotely supervised tDCS in persons with ALS. Successful implementation of a remotely supervised protocol will broaden access to research participants and healthcare by providing therapy in the comfort of one's own home and enable the intensive dosages of treatment that is needed to slow disease progression in persons with ALS.

Topic 7: Adaptive Trials Design

Improving functional outcomes in skilled nursing facilities nationwide: a hybrid I effectiveness-implementation pragmatic clinical trial approach.

Emma Beisheim-Ryan[1,2], Lauren Hinrichs[2], Katie Butera[2], Danielle Derlein[2], Daniel Malone[2], Jodi Holtrop[1,2], Jeri Forster[2,3], Donna Diedrich[4], Jennifer Stevens-Lapsley[1,2]

[1]VA Eastern Colorado Health Care System, [2]University of Colorado Anschutz Medical Campus, [3]Rocky Mountain Regional VA Medical Center, [4]Aegis Therapies

Each year, approximately 1.35 million patients receive skilled nursing facility (SNF) rehabilitation to address hospitalization-associated functional deficits. In SNFs, “usual care” rehabilitation consists of low-intensity interventions, which are often physiologically inadequate to induce improvements in muscle strength and function. In published work, a high-intensity resistance training program (i-STRONGER) resulted in better physical function, increased community discharge rates, and reduced lengths-of-stay among patients receiving SNF care. To further evaluate the role of i-STRONGER in optimizing SNF rehabilitation, we will use a pragmatic clinical trial design to compare patient outcomes between 16 SNFs utilizing i-STRONGER principles and 16 Usual Care sites. We will evaluate i-STRONGER effectiveness and mechanisms underlying successful i-STRONGER implementation using the RE-AIM (Reach, Effectiveness, Adoption, Implementation, and Maintenance) framework. Implementation strategies (e.g., champion selection) have been selected from the Expert Recommendations for Implementation Change (ERIC) to improve program success. During this study, i-STRONGER-site clinicians will undergo a 3-month, self-paced, online i-STRONGER training program; post-training, physical performance data (i.e., gait speed, Short Physical Performance Battery scores) will be collected across all sites for 12 months. Changes in physical performance between patient admission and discharge will be compared across sites to determine Effectiveness. Clinician surveys and focus groups will inform factors influencing Reach (proportion of patients treated with i-STRONGER), Adoption (proportion of clinicians utilizing i-STRONGER), Implementation (i-STRONGER fidelity), and Maintenance (i-STRONGER sustainment). Study findings have the potential to shift SNF rehabilitation care paradigms, optimize patient outcomes and independence, and critically inform future work aimed at large-scale i-STRONGER implementation in rehabilitation settings.

Other Submitted Abstracts

Arranged by Last Name Alphabetically

Spasticity and its Associated Factors in Adults with Attention-Deficit/Hyperactivity Disorder

Mansour Alotaibi[1], Donald Lein[2]
[1]Northern Border University, [2]The University of Alabama at Birmingham

Purpose/hypothesis: Limited evidence found ankle plantarflexors (PF) spasticity in adults with attention-deficit/hyperactivity disorder (ADHD). However, this finding was based on a spasticity subscale of a larger motor examination. We examined hip flexors (HF), knee extensors (KE), and PF spasticity and their associated factors.
Materials/methods: In this cross-sectional study, participants had a 24-hours washout period from their psychostimulant medication before testing, because these medication affects spasticity. Participants underwent the Modified Ashworth Scale (MAS) to assess spasticity of HF, KE, and PF (ranges between 0=normal tone to 4=rigidity). Participant completed three maximum voluntary isometric contractions (MVIC) to examine PF muscle strength and the average of two trials was used (N.m/kg). Participants wore an ActiGraph-GT9X accelerometer around their waist for 7-days to estimate moderate-to-vigorous physical activity (MVPA) minutes/day. We used Spearman-rho correlations to determine associations between MVPA and PF muscle strength with PF spasticity, and to determine these associations among those who have increased PF spasticity (MAS>1).
Results: Forty-two adults with ADHD (33-females; mean age=28.6±6.5 years). Average MVIC, MVPA, and MAS (HF, KE, and PF) were 1.61±0.65N.m/kg, 12.81±12.74minutes/day, and (0.98±1.02, 0.21±0.52, 1.07±1.14), respectively. MVIC and MVPA were associated with MAS of HF (rs=-0.31,p=0.046; rs=-0.43,p=0.008, respectively) and PF (rs=-0.34,p=0.029; rs=-0.42,p=0.010, respectively), but not KE (rs=-0.02,p=0.922; rs=0.07,p=0.672, respectively). Among those who have increased PF spasticity, MVPA was associated with MAS of HF and PF (rs=-0.57,p=0.009; rs=-0.70,p<0.001, respectively).
Conclusion: Adults with ADHD displayed an increased spasticity. Future research should examine if muscle strength training and engaging in physical activity could reduce spasticity in adults with ADHD.

Surviving to Thriving: The Predictive Value of Verbal Fluency Tests in Determining Level of Independence Upon Discharge in Participants with and without Moderate to Severe Traumatic Brain Injury

Ann Cralidis[1], Shannon Salley[1]
[1]Longwood University

Many survivors of moderate to severe traumatic brain injury (TBI) report chronic, disabling cognitive-linguistic sequelae following injury, the presence of which may adversely affect a survivor's ability to function independently upon discharge from rehabilitation. Research has suggested that performance on verbal fluency tasks may be useful in predicting who may or may not have difficulty with independent management of some household tasks such as grocery shopping. In this pilot study, participants with and without moderate to severe TBI were asked to complete phonemic and semantic verbal fluency and grocery shopping tasks. Participants who produced a greater number of correct words on the phonemic task required significantly less time to shop and

were significantly more efficient at shopping. Participants who produced a greater number of repetition errors on the phonemic task only required significantly more time to shop. These findings suggest that verbal fluency testing may be useful in developing specific, targeted treatment protocols and discharge planning.

From Pen and Paper to Technology: Designing App-based Protocols for Remote Monitoring and Individualized Prescription of Vestibular Rehabilitation Exercises

Linda D'Silva[1], Karen Skop[2], Jeremy Martin[3], Katherine Marschner[3], Nathan T. Pickle[3], Timothy Zehnbauer[3], Paulien E. Roos[3]
[1]University of Kansas Medical Center, [2]James Haley VA Hospital, [3]CFD Research Corporation.

At-home exercises are an important part of vestibular rehabilitation for adults with dizziness. Vestibular rehabilitation exercises typically involve gaze stabilization while the head moves in various directions and speeds. Exercises are symptom provoking and patients are often unsure if they are performing the exercises correctly. These factors lead to poor adherence. Studies have shown that less than half the patients perform gaze stability exercises correctly, and at the frequency prescribed. Mistakes are often undetected until the next clinic visit. Limited access and validity of remote monitoring tools require therapists to rely on self-reporting. We developed an app for adults with dizziness that allows remote monitoring and individualized prescription of at-home exercises. It is currently undergoing its first clinical trial with 40 adults between 60-75 years of age with vestibular disorders. Therapists prescribe exercise through the app portal. The exercises are motion-controlled games. The app measures, stores and interprets exercise performance. Encrypted data are sent to a cloud-based storage. Data can be accessible by the clinician or a researcher, with Multifactor authentication required. HIPAA software protocols and HIPAA Amazon Web Services has been integrated into the software- as well as automatic log-off protocols for both the app and web-based portal. Remote monitoring for vestibular rehabilitation has application for both clinical practice and research to provide insights into at-home exercise performance and adherence. The app design can easily be manipulated as evidence on best exercises and dosage program are investigated among a vast population of individuals with dizziness.

Developing Soft Pneumatic Actuators to Assist with Infant Arm Motion

Jared Dube[1], Ipsita Sahin[1], Caio Mucchiani[1], Konstantinos Karydis[1], Elena Kokkoni[1]
[1]University of California, Riverside

Current upper extremity devices for infants remain limited and are mainly passive. Our work focuses on actuated wearable devices for this population. Here, we assess the performance of two pneumatic actuators placed at the shoulder. Actuators support two degree-of-freedom motion on the shoulder (abduction/adduction and horizontal abduction/adduction). Heat-sealable thermoplastic polyurethane-coated nylon fabric was used to fabricate the actuators (dimensions:25.4mmx50.8mm) which contained 1-4 small inflatable cells that were either rectangular or circular in shape. Simulation: Von Mises stress and displacement caused by an applied outward pressure were calculated to determine the actuator type, width and cell number for physical testing as those with low von Mises stress and high displacement values. Experiments: Shoulder actuators containing 1-2 cells were placed on a 1-year old model infant's upper body for abduction/adduction only. Actuators were inflated/ deflated for different time duration for 30 trials each. Motion total path length, smoothness, and shoulder angle were computed. Based on simulation, 1-2 cell rectangular and 1-cell circular actuators were found to be the most viable for physical testing as they reach smaller internal pressure and yield higher displacement. Based on physical testing, 1-cell led to larger total path length while 2-cell actuators saw higher

stability and smoother motion. Physical testing is ongoing for the additional shoulder actuator.

Pharmacokinetics (PK) of N-acetylcysteine (NAC) in Infants of Diabetic Mothers (IDM) Failing Oral Feeds Treated with Transcutaneous Auricular Vagus Nerve Stimulation (taVNS)

Sandra Garner[1], Dorothea Jenkins[1], Bashar Badran[1], Mark George[1], Donald Wiest[1]
[1]Medical University of South Carolina

Background: taVNS improves oral feeding in newborns who are failing oral feeds, but is ineffective in IDM with lower CNS glutathione concentrations [GSH]. This pilot study adds NAC to mitigate oxidative stress and improve the efficacy of taVNS-paired feeding in IDM infants. Intravenous NAC has been safely studied; however, without data for nasogastric (NG) NAC in infants, PK evaluation is necessary. Objective: To determine the PK of NG NAC in IDM receiving taVNS for failing oral feeding and relate to CNS [GSH]. Methods: Following informed consent, we enrolled six IDM slated to receive gastrostomy tubes. Infants received NAC 75mg/kg/dose q6h NG diluted 1:3 with sterile water 1 hour prior to feeds (n=4) or 100mg/kg/dose q6h in 1:2 dilution (n=2), for 4 days prior and with taVNS for 10-14 days. PK parameter estimates were obtained from serial NAC serum concentrations at steady-state, and MRS completed before, during serum sampling times, and at the end of treatment. Results: Enrolled patients were (mean±SD): postmenstrual age= 41±1wks, postnatal age= 47±9d and weight= 4.15±0.47kg. Observed Cmaxss and Cminss NAC concentrations (mean±SD) were 26±12 and 7.7±1.7mcg/mL. PK parameters included t½= 1.8±0.4hours, AUC= 58.7±26.3mcg-hr/mL, and CL= 1107±257mL/hr/kg. NAC was well tolerated other than increased emesis with the 100mg/kg dose. MRS showed increased [GSH] in the basal ganglia at 1.5-2h after NG NAC. Three infants reached full oral feeds. Conclusions: In this first infant NG NAC PK study, t1/2 and CL were faster than neonates receiving IV NAC. Bioavailability was low, but adequate to increase CNS [GSH].

Centering Patient and Care Partner Dyads in Rehabilitation Research and Practice

Monika Gross[1], Rajal Cohen[2]
[1]The Poise Project, [2]University of Idaho

Our presentation advocates for dyadic relationships becoming a primary focus of research and practice for better outcomes and improved quality of life for both patients and “invisible patients” – formal and informal caregivers. Despite the influence of care partners as key stakeholders, little is offered to improve dyadic relationships on a day-to-day basis over time. By enhancing personal agency for both patients and care partners, we can improve the quality of life of both. The Poise Project, a nonprofit in Western North Carolina, led pilot studies over the past six years on Alexander-technique-based programming for care partners and people living with Parkinson’s. Alexander technique is an innovative cognitive approach for embodied agency. We soon noted that when care partners of Parkinson’s patients participated, engagement was higher and outcomes better. Whether a course focused on the needs of the patient or on the needs of the care partner, dyadic relationship improvement became a significant and unexpected secondary outcome of both programs. Dyadic relationships can be improved by joint participation in exercise, art, and dance programs, and with embodied rehabilitation approaches such as Alexander technique. These enjoyable activities allow caregivers and patients to have fun together while also deepening their knowledge and appreciation of one other. We will identify some daily stressors on dyadic relationships, particularly when neurodegenerative and/or cognitive decline is present, and

we will present findings from pilot studies of two Alexander-technique-based courses, delivered both in person and via Zoom, detailing ways we found to increase dyadic retention and satisfaction.

James Hamet[1]
[1]*Vistim Labs, Inc*

The lack of sensitive, objective methods to measure cognitive function in patients with neurological disorders makes clinical trials and drug development lengthy, costly, often yielding low-quality data. In Alzheimer's studies, control participants typically report increased cognitive decline, yet as many as 25% of these do not show performance differences in cognitive assessments. So, we believe greater cognitive resolution is needed. We have developed an approach to solve this problem. Our novel functional EEG-based, AI-enabled cognitive assessment collects real-time stimulated brain activity to enable the direct, objective measurement of early, previously imperceivable changes in cognitive function and to detect symptom onset earlier with greater specificity than existing methods. Data from ongoing clinical trials (n=115) demonstrate our biomarkers can be used to differentiate patients by amyloid status with 90.9% accuracy (sensitivity 91.3%, specificity 90.5%), estimate amyloid burden with a root mean squared error (RMSE) below the typical threshold used for diagnosis (RMSE < 0.15), and separate individuals with high levels of amyloid from those with mild cognitive impairment due to Alzheimer's disease (p=0.002). Most recently, our biomarkers can differentiate patients by psychological performance in the Free and Cued Selective Reminding Test (FCSRT) test with a balanced 80.9% accuracy. We believe we have found an approach to provide the first psycho-physiological assessment of cognition with greater cognitive resolution than other methods. We seek to present our approach for use in the greater scientific community.

Facilitators and Barriers of Implementing 3-Steps Workout for Life to Support Patient Self-care Outcomes in Three Home Health Care Offices

Chiung-ju Liu, Yun Chan Shin, Kellen Breton, Consuelo Maun Kreider, Santanu Datta

PURPOSE: Home health care includes skilled therapy services to support older adults' independence at home. However, the field lacks published therapy practice. The purpose of the study was to evaluate the barriers and facilitators of implementing 3-Step Workout for Life, an evidence-based, task-oriented exerciser program, in three home health offices. METHOD: Administrators and therapy staff were recruited from three local home health offices. Each participant answered interview questions based on the constructs from the domain of "intervention characteristics," "inner setting," "outer setting," and "characteristics of individuals" in the Consolidated Framework for Implementation Research. Directed qualitative content analysis was conducted using Nvivo 12. Barriers and facilitators to each construct were identified for each office. RESULTS: Two administrators, four occupational therapy practitioners, and six physical therapy practitioners completed the interview. Common facilitators across all three offices are in the domain of "intervention characteristics" and "characteristics of individuals." Examples of facilitators are "evidence strength and quality" and "knowledge and beliefs about the intervention." The "inner setting" domain is a facilitator for two offices but a barrier for the third office because of the difference in communications and implementation climate. Finally, external policy (i.e., Medicare) is regarded as a common barrier as well as a facilitator in the "outer setting" domain. CONCLUSION: Identifying facilitators and barriers is beneficial in developing implementation strategies to

support each office in adopting the 3-Step Workout for Life program into their routine rehabilitation therapy care. This study is important to practice because it supports the knowledge translation process from evidence to better patient care.

A Model System for Testing Rehabilitation Interventions: Imposing Temporary Neuromotor and Cognitive Impairments in Healthy Individuals

Julia Manczurowsky[1], Trevor Cline[1], Charles Hillman[1], Christopher J. Hasson[1]
[1]Northeastern University

Neurological impairments are complex, acting across multiple physiological domains. For example, stroke affects coordination, sensation, perception, and cognition; this impairs locomotion, a critical functional activity. Understanding the interplay of neurocognitive and motor impairments could improve rehabilitation, but immense patient variability makes identifying cause-and-effect relationships difficult. Creating a model system to simulate impairments in healthy individuals can address this problem. However, such paradigms typically deliver environmental perturbations that can be overcome in a few steps, limiting generalization to patient populations. Therefore, we developed a model system with a neuromotor perturbation that crosses multiple physiological domains – disrupting muscular coordination, sensory feedback, and cognition – that should prolong adaptation and better reflect the challenges experienced by real patients. This novel approach uses dysfunctional electrical stimulation (DFES) to disrupt muscular coordination, impose temporary discomfort, and impair gait mechanics. This technique briefly stimulates the hamstrings during swing initiation to simulate spasticity and discomfort during treadmill locomotion. Our preliminary results show that, depending on stimulation intensity and timing, we can create a temporary neuromotor impairment that is uncomfortable and challenging to overcome (e.g., requiring ~150 steps to return to baseline). We will report data from an ongoing clinical trial testing the hypothesis that the discoordinative and nociceptive components of DFES have a differential effect on cold (emotionally neutral) and hot (emotional) executive function. Although a model cannot replicate real disorders, our approach can promote an understanding of cause-effect relationships in a low-risk environment to overcome pragmatic barriers before trialing an innovative methodology in patient populations.

Adaptive Recruitment and Retention Strategies for an 'At-risk' Population During the COVID-19 Pandemic

Mansha Mirza, Maureen Gecht-Silver, Heidi Fischer, Mackenzie Konz

This presentation will be based on a pilot randomized control trial to assess the preliminary efficacy of a 12-week manualized occupational therapy intervention focusing on chronic disease management and health promotion in older adults. The intervention included assessment of IADL/ADL functioning and 10 intervention sessions addressing patient-centered goal planning, disease management, physical activity and executive functioning. The trial was launched during the COVID-19 pandemic necessitating changes in intervention delivery and collection of outcome measures. The target population for the study, older adults with uncontrolled diabetes and/or heart disease, was deemed at high risk of severe COVID-19 infection. Therefore, the in-person intervention was adapted for online delivery and all institutionally-recommended COVID-19 safety protocols were implemented. Yet, recruitment and retention continued to be a challenge for multiple reasons. First, previously successful recruitment strategies such as posting flyers at primary care clinics and direct physician referrals were infeasible owing to virtual healthcare appointments, physician burnout, and limited face time

with patients. Recruitment strategies were modified to address these challenges such as patient identification through EHRs followed by push notifications and follow-up phone calls, mass mailing and emailing through senior centers and religious congregations, and virtual lab tours to build confidence among prospective participants about safety protocols. These recruitment and retention strategies continue to evolve with changing phases of the pandemic. The proposed presentation will share details about the challenges encountered, and the relative success of solutions implemented during this trial. This can inform adaptive recruitment and retention protocols in future trials.

Mobile Health Application for Remote Assessment of Children's Motor Skills

Samuel Nemanich[1], Md Raihan Mia[1], Sheikh Iqbal Ahamed[1]
[1]*Marquette University*

Mild-to-moderate motor deficits impact about 5% of all children and are more common in children at risk for developmental problems. Laboratory-based studies of motor function typically involve a single evaluation and might not accurately capture a child's abilities across time and in various environments. Mobile health (mHealth) technologies are capable of objectively measuring movement, however there is a gap in available solutions developed to remotely measure motor skills. The goal of this project is to develop and test an mHealth solution that assesses motor function in children with and without physical disabilities. The current prototype consists of an Apple iOS mobile application featuring games that test fine and visuomotor skills without additional equipment or sensors. Examples of games include tracking a visual target, stacking objects, and finger tapping. Spatiotemporal measures of cursor position (controlled by the hand or a manual stylus) will be stored and uploaded to a secure cloud location for off-line analysis. A parallel system, capitalizing on the existing videorecording features of the mobile device and featuring an animated character that demonstrates gross motor, gait, and balance skills for children to mimic, is also under development. After initial feasibility and usability testing, we will evaluate test-retest reliability and validity of the application compared to gold-standard clinical assessments. The resulting mHealth technology will meet the needs of a post-pandemic world and provide flexibility to researchers and families for gathering data on children's motor skills outside of a traditional laboratory environment.

Lightweight and Smart Robotic Orthoses for Mobility Assistance and Pain Relief in Individuals with Knee Osteoarthritis

Hao Su[1]
[1]*North Carolina State University*

Knee Osteoarthritis (KOA) is a joint disorder that affects approximately 14 million people in the US. It is associated with joint surface degradation and consequent knee pain that reduces mobility and leads to a more sedentary lifestyle with further health sequelae lowering the quality of life. Primary treatment options include surgical interventions, pain medication, joint injections, physical therapy, and bracing; however, they involve high cost, intensive rehabilitation, and have limited efficacy. Advancements in robotics led to the development of robotic orthoses, also known as exoskeletons, that showed promising results in rehabilitation. Commercial exoskeletons, such as Keeogo and ROAM Ascend, propose to offload the knee and thereby slow OA progression and increase mobility. However, these exoskeletons are heavy (~6.7kg), bulky, and have low compliance, which interferes with natural human movements. Therefore, there remains an unmet need for lightweight and compliant wearable robots to alleviate pain and improve functional mobility to sustain an active lifestyle. To

address this gap, we developed a novel lightweight and compliant knee exoskeleton that can work in both unilateral (1.7kg) and bilateral (3.5kg) configurations. The exoskeleton aims to reduce the knee joint load by mitigating the tibiofemoral and patellofemoral contact forces during walking; therefore, it can mitigate pain across a wide range of sub-diagnoses. Furthermore, it consists of a novel lightweight and compliant actuator which facilitates natural human movements and allows for a comfortable experience. Thus, our exoskeleton has the potential to be a preferable solution to reduce pain and improve functional mobility in individuals with KOA.

Remote Ischemic Conditioning Enhances Bimanual Skill Learning and Corticospinal Excitability in Children with Unilateral Cerebral Palsy: A Randomized Controlled Trial

Swati Surkar, John Willson, Jessica Cassidy, Shailesh Gardas, Shailesh Kantak

Background: Unilateral cerebral palsy (UCP) is a leading cause of childhood disability. Children with UCP have difficulty in bimanual coordination that restricts the child's independence and impairs quality of life. Although several efficacious interventions improve bimanual coordination, they require higher training doses and have modest effect sizes. Thus, there is a critical need to find an effective priming agent that, when paired with upper extremity task-specific training, will enhance the magnitude of training effects and subsequently improve functional capabilities of children with UCP. Ischemic conditioning is an endogenous phenomenon to protect an organ from injury by exposing it to a controlled, short-term, local, sublethal ischemia. Remote ischemic conditioning (RIC) is a clinically feasible way of performing ischemic conditioning where episodes of alternating, brief ischemia and reperfusion are delivered with cyclic inflation and deflation of a blood pressure (BP) cuff on the arm or leg. Evidence suggests that the effects of RIC extend from cardio- to neuroprotection. Hence the purposes of study were to determine the effects of RIC + training on bimanual skill performance and corticospinal excitability in children with UCP. Methods: Twelve children with UCP, MACS levels I-III were randomized to receive RIC (n=7; age=12.9 ± 2.2 yrs) or sham conditioning (n=5; age=10.2 ± 3.5 yrs). Pre- and post- assessments included bimanual learning, kinematics of bimanual cup stacking task, and transcranial magnetic stimulation (TMS) measures. RIC was performed via blood pressure (BP) cuff inflation on the affected arm to >20 mmHg above systolic BP and sham conditioning with 25 mmHg using a standard dose of 5 cycles of alternating 5 min of inflation and 5 min of deflation. Each participant underwent the RIC or sham conditioning plus bimanual cup stacking training for 5 consecutive days (15 trials/session). Results: RIC group showed a significant increase ($p=0.04$) in bimanual skill learning (decrease in movement time) compared to the sham group. The motion capture demonstrated greater bimanual coordination (increased movement overlap, goal synchronization, and movement speed in RIC compared to the sham group ($p<0.05$). Similarly, TMS results indicate an increase in corticospinal excitability in RIC compared to the sham group (greater training related changes in resting motor thresholds, increase in intra-cortical facilitation, and increase in motor evoked potentials (MEP) amplitude in the stimulus response curve in RIC compared to the sham group. Conclusions: These preliminary findings suggest that RIC can be harnessed as a priming agent to enhance motor performance and corticospinal excitability in children with UCP.

Movements Improvements from Bimanual Interactive Training Post-Stroke

Martina Verardi, Courtney Celian, Erica Olavarria, Federica Porta, Alessandra Laura Giulia Pedrocchi, James Patton

Bimanual therapeutic training with haptic error augmentation (EA) have shown promise in some recent studies. In a two-arm controlled trial, we explored visual EA, using a visual distortion that instantaneously shifted the

cursor representing the paretic limb in the direction of error. We invited 29 chronic (> 8 months post injury) stroke survivors to practice a bimanual reaching task for approximately 40 minutes, for three weeks. Our predeclared outcome measure, upper extremity Fugl-Meyer, significantly increased an average of 2.2. This increase was mostly retained until a follow-up evaluation 7-9 week later (1.5). No superiority in Fugl-Meyer Gains was detected in the EA treatment group. A composite score that integrated range of motion deficits, bimanual asymmetry, and movement time showed superior improvements for the EA group over the controls that received comparable practice without error augmentation. Such touch-free bimanual therapy may prove to be an inexpensive automated rehabilitation tool. Further work is necessary to determine whether visual error augmentation (without haptics) can provide patients with the most benefit.

Tractographic Delivery with Immediate Dose Assessment in Transcranial Magnetic Stimulation (TMS) with Built-in MRI

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TMS is generally applied with little information about the patient's underlying brain anatomy or tractography. Dose delivery of the electric fields (that are generated by TMS) is not assessed. As a result, it takes weeks to determine if a given patient is going to benefit from therapy. We are building tomographic TMS systems with built-in MRI capability to improve treatment planning and monitoring. We are looking for help in designing and implementing sophisticated human studies to validate the new technology as applied to mental health and neuropathology.

High-Definition Transcranial Direct Current Stimulation for Upper Extremity Rehabilitation Post Stroke: A Pilot Trial in Oklahoma

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Stroke is the leading cause of serious long-term disability in United States. The specific upper-extremity motor impairments that occur post stroke include muscle weakness, abnormal muscle synergies, and spasticity. These impairments occur due to damage to the corticospinal tract and in result, upregulation of the cortico-reticulospinal spinal tract. Recent studies have demonstrated that transcranial direct current stimulation (tDCS) can be a potentially effective treatment for stroke rehabilitation. However, conventional tDCS is limited by spatial resolution to precisely target a specific brain region. To improve its spatial resolution, this study used targeted high-definition tDCS (HD-tDCS) navigated by paired-pulse transcranial magnetic stimulation (TMS). In a randomized double blind crossover study, chronic stroke participants had three visits 1) anodal HD-tDCS stimulation of the arm region of the primary motor cortex (M1) to improve function of the corticospinal tract in the lesioned hemisphere, 2) cathodal stimulation of the arm region of the dorsal premotor (PM) cortex to inhibit maladaptive use of the cortico-reticulospinal tract in the contralesional hemisphere, and 3) sham. The preliminary results demonstrate that anodal stimulation increased Fugl-Meyer Upper Extremity scores. Both anodal and cathodal stimulation decreased the latency of ipsilesional M1 TMS induced contralateral motor-evoked potentials (MEP) of affected arm muscles and changed the status of contralesional PM TMS induced ipsilateral MEP from positive (detected) to negative (not detected). These results indicate that both anodal and cathodal HD-tDCS can improve the function of motor descending pathways, while anodal stimulation appears to be more effective on improving the motor function of the upper extremity. This work is supported by the Oklahoma Shared Clinical and Translational Resources (U54GM104938) with an Institutional Development

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Using sTMS to Evaluate Acupuncture Effect on Acute Stroke Patients: Case Series

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The researchers are investigating the effects of acupuncture by measuring the amplitude of motor evoked potentials (MEPs) stimulated by single-pulse Transcranial Magnetic Stimulation (sTMS) on acute stroke patients 5-15 days after their stroke with flaccid hemiparesis in an inpatient rehabilitation setting. The subjects participated in a randomized controlled trial. Participants randomized to the experimental group received three to five consecutive days of acupuncture sessions lasting approximately 45 minutes and 3 hours of conventional therapy. The control group received 3 hours of regular therapy per day. Both groups received two sessions of sTMS before the administration of acupuncture and three to five days after the start of the trial. sTMS is given at an intensity of 120% of the motor threshold. An EMG of the abductor pollicis brevis measured MEPs. The mean of the amplitudes of 10 pulses was calculated for both sessions. Two participants enrolled in the study. One participant in the acupuncture group had an MEP average of 768.3 mV with 14.72 stdev of prior and 794.6 mV with 124.76 stdev of post-treatment. The subject in the control group had an MEP average of 682.3 mV with 32.35 stdev prior and 1181.2 mV with 2.66 stdev post-treatment. The case series demonstrates the feasibility of this study in an acute Inpatient Rehabilitation setting. The difference in MEP amplitude was not significant in the treatment group but was greater in the control group. Continued research is necessary to better assess the effectiveness of acupuncture on neuroplasticity in stroke patients.

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