



PROGRAM

Rehabilitation Engineering Research Center on Mobile Rehabilitation (mRehab RERC) State of the Science Conference:

The Future of mRehab for People with Disabilities

DAY 1.0

Saturday, October 28, 2023

Session 1: Adherence to and effectiveness of home/remote therapeutic exercise

Moderator/Discussant: *Frank Deruyter*

1.1. Clinician Strategies and Perspectives on Patient Adherence to Home Exercise Programs

Raeda Anderson, Shepherd Center

Examination of patient home exercise program adherence from clinicians working with patients to develop and maintain home exercises with emphasis on trends and perspectives of Physical Therapists, Occupational Therapists, and Speech Therapists. Home exercise adherence is assessed from multiple angles to understand patterns of clinician exercise assignment, patient adherence, and patient improvement trajectories. To better understand nuances of adherence, a thorough analysis of the facilitators and barriers to adherence commonly experienced by patients and the interventions employed from clinicians are tested.

Learning Objectives

1. Understand patterns of home exercise programs and projected patient improvement outcomes.
2. Identify barriers to adherence in home exercise programs as well as interventions to reduce the effect of those barriers.

1.2. Inclusiveness and cultural relevance for developing mRehab Interventions

Sutanuka Bhattacharjya, Georgia State University

Using mHealth technology allows users to engage in in-home rehabilitative activities while monitoring their own performance and managing their own health behaviors. Smartphone-based rehabilitation programs need to be culturally tailored to increase adoption. Over the years, research has shown a “link between cultural factors and the acceptance of technology”. A culturally adapted design allows the user to successfully perform the task and experience greater satisfaction which plays a crucial role in the user’s perception of usability. In most cases, the lack of adoption can occur because designers didn’t consider cultural context when designing these applications. Mobile health (mHealth) interventions seem to be developed and implemented in a sociocultural vacuum”. This presentation will discuss factors that can

influence inclusiveness of mRehab interventions. The presenter will also provide examples and case scenarios of culturally tailoring mRehab interventions to increase inclusiveness and lead to greater adoption of mRehab interventions.

Learning objectives:

- 1) List at least 5 factors that can limit inclusiveness of mRehab interventions.
- 2) Provide examples of strategies that be used to increase inclusiveness when developing mRehab interventions.

1.3. Patient-Centered mRehab for Self-Management of Chronic Conditions

Candice Osborne, Craig Hospital

mRehab to support individuals with chronic conditions is rapidly growing. Many mRehab interventions are designed to support self-monitoring and maintenance of health as well as long-term adherence to self-management interventions initiated in a clinical setting. These mRehab interventions include evidence-based education, support for self-care tasks, tracking of biometrics and symptoms, facilitation of provider-patient communication, and support for comprehensive self-management. A total of 69% of US adults track at least one health indicator using a mobile device, and individuals with chronic conditions are significantly more likely to track health indicators compared to those without chronic conditions. This presentation will provide an overview of mRehab for self-management of chronic conditions, delineate the importance of user-centered mRehab content, design and features, discuss limitation and pitfalls of mRehab implementation for self-management, and provide examples of mRehab for self-management currently available or under study.

Learning objectives

1. Participants will gain insight into the state of the science of mRehab designed to support the self-management of chronic conditions—current science and future directions.
2. Participants will gain insight into mRehab development--the importance of user-centered content, design and features.

Session 2: Technology for remote monitoring and support

Moderator/Discussant: *David Reinkensmeyer*

2.1. Motivating and Monitoring Patient Activity in the Home and Community Using Gamified Sensor Technology

Daniel Zondervan, Flint Rehabilitation Devices

The standard of care for home exercise after an injury continues to be a relatively low-tech solution (for example, paper exercises) that does not measure a patient's actual movement. While using sensors to measure detailed kinematics remains aspirational, we have shown significant and clinically meaningful benefits to using even simple sensor systems to motivate and monitor at home exercise. Here, we will discuss several sensor platforms we have developed for at home exercise and transitioned into successful commercial products, all of which share the use of gamification as a unifying theme. We will also share recommended design features for commercial uptake and clinical results from randomized controlled studies of these devices.

Learning objectives

1. Identify clinical benefits from simple sensor systems for motivating and monitoring home exercise.
2. Explain recommended design features for simple sensor systems for home rehabilitation.

2.2. Designing and Implementing an AI Conversational Agent for Behavior Activation in People with Brain Injury

*Amanda Rabinowitz, Moss Rehabilitation Research Institute
George Collier, Shepherd Center*

This talk will present a framework for chatbot intervention development using RehaBot, an interactive chatbot accessed via text messaging, designed to augment a face-to-face behavioral activation treatment for reducing depression and increasing participation in individuals with moderate to severe traumatic brain injury. We will present background on the underlying software architecture of the chatbot, as well as a framework to guide the selection and design of chatbot-delivered interventions based on the COM-B Model of Behavior Change (Michie et al., 2014). We will also discuss the user-centered design process, which heavily involves consumer input. Our findings provide preliminary evidence suggesting that RehaBot is usable and may promote better adherence to planned target activities. This design process may serve as a model for the development of future chatbot-assisted interventions.

Learning objectives

1. Explain a framework to guide the selection and design of chatbot-delivered rehabilitation interventions.
2. Identify preliminary evidence that Chatbots may be usable and promote adherence.

2.3. Perspectives of Stakeholders to Facilitate Uptake and Adoption of Wearable Technology in Stroke Rehabilitation

Marika Demers, Université de Montréal, CRIR–Institut universitaire sur la réadaptation en déficience physique de Montréal IURDPM

Wearable technology can be used as both a contextually relevant assessment method and simultaneously an intervention modality by providing direct feedback on activity to stroke survivors. User-centered design is crucial for the development of user-friendly and clinically relevant wearable technology. This presentation will discuss how feedback metrics from wearable technology can be leveraged to promote behavior change and how clinicians envision using wearable technology within everyday practice. Recommendations for knowledge translation and clinical uptake will be presented. There is tremendous potential for stroke researchers and clinicians to take advantage of wearable technology to better understand functional behaviors outside restricted clinical settings and deliver personalized and simple interventions that drive health-promoting behaviors.

Learning objectives

1. Appraise the relevance of data from wearable technology.
2. Identify necessary next steps to integrate wearable technology in research and clinical practice.

Session 3: Analytic techniques for managing “Big Data” available from mRehab

Moderator/Discussant: *Mike Jones*

3.1. Novel Use of mHealth Data to Identify Vulnerability and Receptivity to Just-in-Time Adaptive Interventions

James Rehg, University of Illinois-Champaign

Digital biomarkers obtained from mobile sensors provide unprecedented opportunities to effect a new paradigm for maintaining health and managing disease: the delivery of behavioral and other digital therapeutic interventions anytime anywhere at the optimal time and place for each individual, an approach which is enabled by the paradigm of Just-in-Time Adaptive Interventions (JITAs). In order to achieve this vision, significant technical and research challenges must be overcome. This talk will provide an overview of these challenges and the solutions that we are developing as part of the NIH-funded mHealth Center for Discovery, Optimization & Translation of Temporally-Precise Interventions (mDOT).

Learning objectives

1. Understand how digital biomarkers obtained from mobile sensors can be incorporated into Mobile Health interventions.
2. Explain how digital biomarkers can be used to tailor just-in-time adaptive interventions for individual patients.
3. Identify risk markers for poor health outcomes and how they can be used to tailor interventions and gauge their effectiveness.
4. Understand use of Time Series Imputation to evaluate effectiveness of interventions.

3.2. Translating Accelerations into Participation: Big Data, Latent Variables, and Challenges of Actigraphy

Keith Lohse, Washington University, St. Louis

To assess the effectiveness of interventions in research or in clinical practice we need valid and reliable outcome measures. Unfortunately, clinical assessments typically measure the capacity for an activity under ideal conditions, which does not correlate with performance of activities in daily life. Similarly, patient-reported outcomes are vulnerable to confounding effects of confidence/self-efficacy and often over-estimate the performance of activities in daily life. Remote sensors thus offer an appealing alternative for obtaining objective measures of performance “in vivo”. However, using sensors to track steps (in the lower extremities) or coordination (in the upper extremities) is not an easy or direct process. In this talk, I will describe the data pipeline transforming raw sensor data into actionable clinical outcomes that can be useful to clinicians and patients and the difficulties of balancing complexity, generalizability, and clinical interpretability.

Learning objectives

1. Explain the disparity between the capacity for an activity and the performance of activities in daily life, necessitating remote measurement.
2. Identify and describe key aspects of the data pipeline that creates a closed loop from raw sensor data to actionable clinical outcomes in the electronic medical record.

3.3. Building an automated chatbot coaching system to encourage effective engagement with a home rehabilitation game for stroke survivors

Sangjoon Kim, University of California, Irvine
George Collier, Shepherd Center

Home-based exercise is an essential component of stroke rehabilitation. Such exercise can be embedded in computerized gaming systems to increase engagement. Analysis of a historical dataset (big data) from a home-based rehabilitation system called FitMi showed that over one-half of the patients abandoned the FitMi system after four weeks, undermining achievable improvements. In this talk, we will present an automated coaching system that can be delivered via a chatbot to improve the long-term engagement of FitMi. For developing an automated coaching system, a crucial need is finding the most effective approach to provide coaching. A standard approach is applying scientific theories (e.g., habit formation theories) by embedding them into rules or an algorithm. Alternatively, we can apply machine learning techniques and train an AI coach in effective practice. We plan to implement both approaches and compare their effectiveness. This study may provide insight into the development of future chatbot-assisted interventions.

Learning Objectives

1. Distinguish between 2 approaches to developing automated coaching programs: behavioral/psychological theory and machine learning.
 2. Explain the process for incorporating both behavioral/psychological theory and machine learning in an automated coaching program.
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DAY 1.5

Sunday, October 29, 2023

Session 4: Barriers and facilitators to uptake and adoption of mRehab

Moderator/Discussant: *John Morris*

4.1. Barriers and Facilitators to Integrating Mobile Rehabilitation Technologies into Clinical Practice

Lauri Bishop, University of Miami

Current models of rehabilitation are often insufficient at reducing impairments, restoring function after injuries, and giving individuals the skills to return to participation in home and community settings. As clinicians and researchers, we often seek additional tools that can be used to augment current rehabilitation efforts. Mobile technologies (mHealth) have made it possible to record metrics of physical activity and can be used as tools to gain insight into movement behaviors outside of therapy clinics. The purpose of this talk is to introduce common mHealth technologies that can be used as an adjunct in rehabilitation and to discuss the limitations and benefits of integrating mHealth technologies into clinical practice.

Learning Objectives

1. Identify common mobile technologies that can be used in clinical practice.
2. Discuss advantages and limitations of common mobile technologies.
3. Assess barriers and facilitators to mobile technologies for integration into clinical care.

4.2. Regulatory and Reimbursement Environment for mHealth/mRehab Interventions and Future Directions

Stephanie D. Barnes, JD, PhD, Senior Counsel, Nixon Gwilt Law

This presentation will review recent innovations and possible future directions of policymaking for healthcare data analytics, privacy/security, remote physiologic monitoring, remote therapeutic monitoring, patient engagement, artificial intelligence, wearable technology, mobile health apps—and the compliant business arrangements, reimbursement pathways, and strategies needed to fuel those innovations. Economic, social, technology and policy trends will be discussed, followed by in-depth analysis of current opportunities and challenges to advancing the development and adoption of mobile health/rehabilitation innovations. Finally, a crystal ball view of future pathways for mobile rehabilitation over the next 5 years will be discussed.

Learning objectives

1. Identify at least 3 opportunities and limitations for implementation of remote physiologic/therapeutic monitoring (RPM/RTM) under current reimbursement policies.
2. Explain how economic, business, social and technological trends will shape public policy related to FDA review, insurance reimbursement and information security for innovative technologies to support RPM/RTM.
3. Identify and explain at least 1 scenario for the future development of mobile rehabilitation over the next 5 years.

4.3. Implementation of an mRehab Architecture in an Outpatient Clinic

Veronica Swanson, University of California, Irvine

Mike Jones, Shepherd Center

With the expansion of remote monitoring billing codes, healthcare providers can provide new dimensions of care, but thoughtful implementation is needed to successfully introduce a new intervention into an organization. This talk describes the exploratory implementation of an mRehab system in an outpatient clinic during the beginning of the COVID-19 pandemic. This Sensor Enhanced Activity Management (SEAM) system combines a home exercise program (HEP) management software with a movement sensor for monitoring and motivating HEP adherence. Three therapists used the system in their regular practice and attempted to gain reimbursement using Remote Physiologic Monitoring (RPM) codes. Interviews with therapists, exercise data from the SEAM system, and billing and reimbursement data were collected during the trial. Therapists reported that remote monitoring was motivating to their patients and increased adherence. Remote monitoring codes may enable reimbursement for review and program management activities. Sustained technical support for therapists will likely improve implementation of new remote monitoring and treatment systems.

Learning Objectives

1. Describe primary barriers to implementing an mRehab system in an outpatient clinic.
2. Describe potential benefits of using an mRehab system.