

The cover features a background image of a person in a laboratory setting, overlaid with a semi-transparent orange filter. The person appears to be working with a piece of equipment that has a control panel with a vertical list of numbers 1 through 5. The right side of the cover is a solid dark blue vertical band.

#HERL QUARTERLY

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PUBLICATIONS

Salma Azzouzi, Catherine Stratton, Laura Paulina Muñoz-Velasco, Maryam Fourtassi, Bo-Young Hong, Rory Cooper, Joseph K. Balikuddembe, Angela Palomba, Mark Peterson, Uma Pandiyan, Andrei Krassioukov, Deo Rishi Tripathi, Yetsa A. Tuakli-Wosornu, and Abderrazak Hajjioui

The huge burden and vulnerability imposed by non-communicable diseases (NCDs) during the COVID-19 pandemic highlighted how healthy lifestyle behaviors and the well-being of people living with NCDs need to be prioritized. The aim of our study is to better understand the impact of the COVID-19 pandemic on healthy lifestyle behaviors and perceived mental and physical health among adults living with NCDs, as compared to people without NCDs. We conducted a cross-sectional study using a global online survey through Qualtrics. Over four months, 3550 participants from 65 countries worldwide responded to the survey. The study included 3079 surveys with no missing data (complete survey responses) that were used for analysis. People with NCDs were more likely to report statistically significant worsening physical health ($p = 0.001$) and statistically insignificant worsening mental health ($p = 0.354$) when compared to pre-pandemic levels. They reported lower rates of smoking during the pandemic than those without NCDs, and a statistically significant ($p < 0.001$) relationship was found between weight gain and NCDs. Therefore, the perceived physical and mental health, including changes in body weight and tobacco consumption, of people with NCDs were significantly impacted during the pandemic. In conclusion, this study indicates that the pandemic had a significant impact on perceived physical and mental health, changes in body weight, and tobacco consumption among people with NCDs.

S. Andrea SundaramHuman, Cheng-Shiu Chung, Benjamin Gebrosky, Joshua Brown, Garrett G. Grindle, Nikitha Deepak, Rosemarie Cooper, & Rory A. Cooper

Current clinical practice guidelines (CPG) recommend periodic pressure redistribution (PR) to alter sitting pressure and reduce the risk of developing pressure injuries (PI). Individuals who have strength and trunk stability are asked to perform PR such as wheelies, leaning laterally, and forward-leaning to minimize the duration of pressure acting on the same region of the body. Our long-term objective is to build upon previous research and development to create a more effective device for improving PR training and adherence to CPG among manual wheelchair users (MWU). Through this study, we employed a participatory action design and engineering (PADE) approach in developing the hardware and user interface to increase the likelihood of eventually yielding a device effective for both MWU and clinicians.

Eliana Chaves Ferrettia, Haidar Tafner, Luana Foroni Andrade, Rory A. Cooper, & Patrícia Coelho de Soárez

To identify and synthesise the available evidence on the effect of mobility on social participation and quality of life (QoL) of wheelchairs (WC) on adults who use WC as their primary means of mobility. Systematic review undertaken in accordance with the Centre for Reviews and Dissemination Guidelines and registered in the PROSPERO International Prospective Register of Systematic reviews. Nine electronic databases (MEDLINE via PubMed, EMBASE, Cochrane Library, LILACS, CINAHL, PEDro, SCOPUS, Web of Science, and BVS ECOS) were searched with the following PICO eligibility criteria: (P) Population was individuals with mobility limitations that live in their community, aged 18 or older; (I) Intervention was mobility devices, such as manual and powered wheelchairs; (C) Comparators, not applied; (O) Outcome was factors that can be influenced by wheelchair use, such as: social participation, health-related quality of life and QOL. Critical appraisal of methodological quality of studies were undertaken.

Denis R. Newman-Griffis, Max B. Hurwitz, Gina P. McKernan, Amy J. Houtrow, Brad E. Dicianno

People with disabilities disproportionately experience negative health outcomes. Purposeful analysis of information on all aspects of the experience of disability across individuals and populations can guide interventions to reduce health inequities in care and outcomes. Such an analysis requires more holistic information on individual function, precursors and predictors, and environmental and personal factors than is systematically collected in current practice. We identify 3 key information barriers to more equitable information: (1) a lack of information on contextual factors that affect a person's experience of function; (2) underemphasis of the patient's voice, perspective, and goals in the electronic health record; and (3) a lack of standardized locations in the electronic health record to record observations of function and context. Through analysis of rehabilitation data, we have identified ways to mitigate these barriers through the development of digital health technologies to better capture and analyze information about the experience of function. We propose 3 directions for future research on using digital health technologies, particularly natural language processing (NLP), to facilitate capturing a more holistic picture of a patient's unique experience: (1) analyzing existing information on function in free text documentation; (2) developing new NLP-driven methods to collect information on contextual factors; and (3) collecting and analyzing patient-reported descriptions of personal perceptions and goals. Multidisciplinary collaboration between rehabilitation experts and data scientists to advance these research directions will yield practical technologies to help reduce inequities and improve care for all populations.

Stephanie K. Rigot, Michael L. Boninger, Dan Ding, Jennifer L. Collinger, Brad E. Dicianno, & Lynn A. Worobey

To evaluate the relationship between measures of neuromuscular impairment and limb accelerations (LA) collected during sleep among individuals with chronic spinal cord injury (SCI) to provide evidence of construct and concurrent validity for LA as a clinically meaningful measure. The strength (lower extremity motor score), sensation (summed lower limb light touch scores), and spasticity (categorized lower limb Modified Ashworth Scale) were measured from 40 adults with chronic (≥ 1 year) SCI. Demographics, pain, sleep quality, and other covariate or confounding factors were measured using self-report questionnaires. Each participant then wore ActiGraph GT9X Link accelerometers on their ankles and wrist continuously for 1–5 days to measure LA from movements during sleep. Regression models with built-in feature selection were used to determine the most relevant LA features and the association to each measure of impairment.

Cheng-Shiu Chung, Garrett G Grindle, Joshua D Brown, Benjamin Gebrosky, Wei Carrigan, Pavan Nuthi, Muthu B J Wijesundara, & Rory A Cooper

Develop an anthropomorphic model cushion rigid loading indenter with embedded sensors (AMCRLI-ES) to assess compression and shear forces at key locations such as trochanters and ischial tuberosities. The sensor design was optimized using finite element analysis. The AMCRLI-ES was designed with the same dimensions as specified in ISO 16840-2 tests. The AMCRLI-ES is divided into eight independent sections, and each section consists of one 3-axis load cell sensor to measure compression and shear forces normal to the compression direction. Six commercial cushions were tested using the AMCRLI-ES with standard ISO 16840-2 testing procedures. Statistical differences were found for energy dissipation between cushions. Statistical differences ($p < 0.001$) were found in all stiffness values. Test results showed that energy dissipation (ED) was correlated with hysteresis at 500 N with moderate to high Pearson product correlation $r = -0.537$, $p = 0.022$. The hysteresis at 250 N did not show a statistical correlation with ED. The AMCRLI-ES demonstrated the ability to measure compression and shear forces at key locations on the cushion including the thigh, trochanter, ischial tuberosity, and sacral area. It provides in-depth information about how the weight was distributed on the cushions.

Saleh A Alqahtani, Cheng-shui Chung, Theresa M Crytzer, Carmen P DiGiovine, Eliana C Ferretti, Sara Múnera Orozco, S Andrea Sundaram, Brandon Daveler, María L Toro-Hernández, Amy Lane, Tamra Pelleschi, Rosemarie Cooper, Rory A Cooper

In chapter 12, the reader will be able to learn about rehabilitation engineering, seating, and mobility. After providing a brief introduction, the chapter describes the model for assistive technology service delivery, transportation options for wheelchair users, and principles of basic seating. The text then explains the different options of advanced robotic wheelchairs, followed by the principles of basic wheelchair design. In addition, the chapter will highlight the guidelines that wheelchair users can follow to maintain their wheelchairs at home. The chapter then proceeds to discuss rehabilitation engineers' role in the customization and integration of assistive technology solutions for clients.

TRANSPORTATION: A STUDY OF TECHNOLOGY AND PEOPLE

HERL's research projects on **Transportation** target to address the need of people living with a disability that limits their ability to travel, especially those relying on wheeled mobility devices including manual wheelchairs, powered wheelchairs, and scooters. For such individuals, a reliable method of transportation is necessary to be able to work or attend school, and actively participate in the community. Public transportation may be unreliable in some communities and have limited flexibility. Paratransit or accessible taxi may require scheduling ahead of time, so impromptu use of the services may not be possible. As these limitations are exacerbated for those who live in suburban and rural areas, wheelchair users are highly dependent on personal vehicles.



TRANSPORTATION BOARD GAME

A prototype of a transportation board game was developed by researchers from HERL and the Catholic University of America. The game was developed to address travel barriers for people with disabilities and to enhance the awareness and knowledge of stakeholders (including healthcare providers, engineers, and transportation system operators/designers). The game was developed based on previous research identifying travel barriers for people with disabilities when using different modes of transportation, conducted by the HERL research team. This prototype will be revised and expanded in future projects. We expect this board game to promote behavioral changes in stakeholders and it may lead to reduction in travel barriers for people with disabilities.



MEBot

The mobility enhancement robot (MEBot) wheelchair being loaded into a non-accessible minivan and operated remotely by its user. Typical minivans require vehicle modifications to bring the power wheelchair into the vehicle (e.g. power ramps, and lifts). These modifications are costly and complex which may compromise the vehicle's structure. Alternatively, the MEBot wheelchair offers height adjustable legged-wheels and a configurable footprint to negotiate steps of different heights; hence, improving user access into the vehicle without the need of additional modifications.



WHEELCHAIR DOCKING SYSTEM

To drive or ride as a passenger in a personal vehicle, a wheelchair docking system (WDS) that secures the wheelchair within the vehicle is essential for mobility device users. To address some issues related to the pin-based docking systems and to some extent 4-point tiedown systems, HERL is conducting a study of a prototype of a low-profile automatic WDS to investigate usability, task load, comfort, and security as compared to other WDSs.



3D SCANNING

3D scanning being performed of a standard minivan to gather dimensions for creating a 3D model of the vehicle. The 3D scanning was being performed because we're developing a wheelchair that will be capable of being driven into a minivan that is minimally modified. Typical accessible minivans have the floor lowered and a powered ramp installed. However, these modifications are very costly and we are attempting to develop a wheelchair that is able to be driven into the vehicle using a portable style ramp and transported with the user without these expensive modifications, thus making personal transportation cheaper and expanding it to a greater number of individuals who may not be able to afford the expensive cost of an accessible vehicle.

PATENTS & AWARDS

Dr. Rory Cooper has been inducted into the National Inventors Hall of Fame. He will be among one of sixteen inductees for the class of 2023. The induction ceremony will take place in Washington D.C. on October 26. For more info on Dr. Cooper's award click

HERL patent has been issued for the PneuChair on Nov 22, 2022

Each year HERL recognizes an individual or individuals who have gone above and beyond with their work here at HERL. Staff members selected Katie Sears and Josh Marino to be the recipients of the 2022 Staff Member of the year!



George Wittenberg, MD, PhD, was awarded a VA SPiRE project beginning 12/1/2022. Dr. Wittenberg is a Neurologist in VAPHS, Director of the Laboratory for Research on Arm Function and Therapy (RAFT), affiliated with the Rehabilitation Neural Engineering Labs of the University of Pittsburgh and HERL Research Investigator. The project is titled, Multimodal Guidance towards Precision Rehabilitation to Improve Upper Extremity Function in Stroke Patients.

Jorge Candiotti, PhD is a Career Development awardee and was awarded a CDA level 2. The project title is Field Usability Testing of a robotic wheelchair with passive-active suspension for seat stability in uneven terrains. He also received a leadership award from VA-ORD from July-December 2022.

S. Andrea Sundaram was awarded the Thomas O'Connor Award the recipient is outstanding doctoral student who demonstrates strong interest, leadership and commitment to the rehabilitation science and technology field and engages in volunteerism and community service.

IN THE PRESS

VISITORS



Korean Paralympic committee



Architecture and Design students/faculty from Catholic University of America.



Sunrise Medical

HERL OUT AND ABOUT



We said goodbye to our new friend and HERLer Celia Lopez. We will miss you, Celia! Good Luck in Brazil.

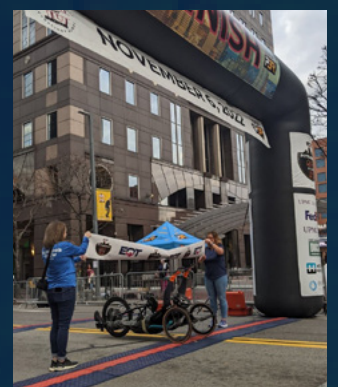


David Gifford and Dr. Alicia Koontz completed the last leg of the Gap Relay

November 5th was Pitt's Salute to Service Football Game. We honored the military service community for their commitment to protecting the USA.



Pittsburgh 10 Miler Race



STILL IN NEED OF PARTICIPANTS FOR OUR STUDIES

Principal Investigator: Alicia Koontz, PhD



This is a research study conducted by the University of Pittsburgh. The purpose of this study is to examine the Caregiver Assisted Transfer Technique Instrument (CATT), which has been developed as a tool to assess proper technique of caregivers who provide transfer assistance to individuals with physical disabilities.

YOU MAY BE ELIGIBLE TO PARTICIPATE IF YOU ARE:

- Over the age of 18 years old
- Routinely provides transfer assistance to an adult with a physical disability for at least two years
- Served as a caregiver for at least three months
- Have no formal training on assisted transfer techniques

This study will require two visits for care recipients and up to four visits for caregivers, and you will have the option to participate remotely in your home. For the first visit, you will be asked to complete surveys and perform routine transfers to be evaluated. For the second visit you will be asked to perform the same transfer procedures as visit one. Visits three and four for caregivers involve completing an online assessment of their transfer skills. Care recipients could earn up to \$50 and caregivers could earn up to \$100 for participation in the study. Caregivers will be given the opportunity to participate in an option sensor portion of the study for an additional \$50.

THE CARE GIVER ASSISTED TRANSFER TECHNIQUE (CATT) STUDY IS ACCEPTING PARTICIPANTS THROUGH DECEMBER 2023!

Principal Investigator: Alicia Koontz, PhD



The purpose of this research study is to examine how in-wheel suspension in manual wheelchairs changes vibrational exposure and how this impacts pain and fatigue.

YOU ARE ELIGIBLE TO PARTICIPATE IF:

- You have an SCI which occurred at least one year ago
- You use a manual wheelchair fulltime (>30 hours per week)
- You use a manual wheelchair with 24" or 25" quick-release wheels
- Your wheelchair does not have in-frame suspension elements
- You weigh under 265 lbs. (weight limit of suspension wheels)
- You have moderate chronic neck/ or back pain

This study will require two visits and 12 weeks of at-home in-wheel suspension use. During your first lab visit, you will be asked to complete a standardized mobility course of various surfaces and obstacles you may encounter during daily activities of living. You could earn up to \$250 for your time!

FOR MORE INFO ON EFFECTS OF IN-WHEEL SUSPENSION IN REDUCING VIBRATION, NECK, AND BACK PAIN STUDY CALL 412-407-2047 AND MENTION "IN-WHEEL SUSPENSION STUDY"

Principal Investigator: Rory Cooper, PhD



This research study will collect feedback from rehabilitation professionals and caregivers on the PPTS transfer process and the new custom seating system.

YOU MAY BE ELIGIBLE TO PARTICIPATE IF YOU ARE:

- Are over the age of 18 years.
- Weigh less than 250 pounds (weight limit of device).
- Fit an 18-inch-wide and 18-inch-deep seat.
- Are a rehabilitation professional (therapists, caregivers, physicians, nurses, attendants and aides) with experience transferring adults with complex disabilities who use Electric Power Wheelchair (EPW)

PARTICIPANTS WILL BE ASKED TO:

- Transfer a rescue dummy from the EPW to the bed using PPTS.
- Compare the test wheelchair with the original manufacturer's seating by maneuvering the wheelchairs through a few obstacles and evaluating them through a series of questionnaires.
- Complete additional testing of the PPTS which will involve evaluating the transfer process, if needed.

The study will take one visit lasting no longer than three hours. Participants may be compensated up to \$80 for completing the study. Location: Human Engineering Research Laboratories (Bakery Square, 6425 Penn Ave., Suite 400, Pittsburgh, PA, 15206). CALL 412-417-7923 for more information!

THE CARE GIVER ASSISTED TRANSFER TECHNIQUE (CATT) STUDY IS ACCEPTING PARTICIPANTS THROUGH FEBRUARY 2023!

A THANK YOU TO OUR PARTICIPANTS!

Thank you to all research participants who have volunteered their time to participate in our HERL studies! We value the contributions and loyalty to HERL and we look forward to continued participation in HERL research activities.

Undergraduates seeking an in-depth summer research experience should consider the American Student Placements in Rehabilitation Engineering (ASPIRE) program at HERL. ASPIRE is:

- A ten-week research program at the University of Pittsburgh's Human Engineering Research Laboratories
- Sponsored by the National Science Foundation (NSF)
- Emphasis on research in the rehabilitation engineering and assistive technology fields

In addition to full participation in an on-going HERL research project, students are presented with numerous opportunities for personal and professional development via faculty workshops. ASPIRE participants will write a project paper, develop a poster, and compete in an elevator pitch competition based on their research assignment. The program concludes with the Final Symposium where the winners of the best paper, poster, and elevator pitch are recognized.

For more information contact Josh Marino at josh.marino@pitt.edu



2022 ELEVATE CAMPAIGN A SUCCESS!

We thank our donors for their generous contributions to 2022 Elevate campaign! We are happy to let you know that we have well exceeded our goal! This will allow us to continue the educational support of student veterans. Thank you for your loyalty and friendship!

Scan or click QR Code to Donate!

PITT DAY OF GIVING FEBRUARY 21

Without your support the Human Engineering Research Laboratories would not be able to have accomplished all it has today! We thank you from the bottom of our hearts for the generosity as we strive to keep improving assistive technology.

Our mission here at HERL is to continuously improve the mobility and function of people with disabilities through advanced engineering in clinical research and medical rehabilitation and our vision is to create a world where all people with disabilities have unencumbered mobility and function so that they can fully participate in and contribute to society. Without all your support and donations, HERL wouldn't be what is without you today and for that we thank you!

- RORY COOPER, PHD**
Director
- BRAD DICIANNO, MD**
Medical Director
- ALICIA KOONTZ, PHD, RET**
Senior Associate Director for Research
- ROSEMARIE COOPER, MPT**
Associate Director for Stakeholder Engagement
- GARRET GRINDLE, PHD**
Associate Director for Engineering
- ANDREA BAGAY, BS, CRA**
Administrative Officer and Assistant Director for VA Finance & Research Administration
- BARB KLIPA, MBA**
Assistant Director for Finance & Research Administration
- GINA MCKERMAN, PHD**
Assistant Director for Data Science
- D. JOSHUA MARINO, MS, ATC**
Assistant Director for Education and Outreach
- NIKITHA DEEPAK, MS**
Assistant Director for Research Coordination and Regulatory Compliance

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CONTACT HERL

6425 Penn Avenue, Suite 400

Pittsburgh, PA 15206-4022

Phone: 412-822-3700

Fax: 412-822-1079

Email: herl@groups.pitt.edu