

**Use of Functional Ambulation Performance Score as measurement of gait ability: Review**

Arnaud Gouelle, PhD

Gait analysis systems provide useful information to the clinician for assessing gait disabilities and evaluating improvements following a rehabilitation program. To facilitate the analysis of the extensive data yielded, summary measures have been proposed. For example, the Functional Ambulation Performance Score (FAPS) includes, in a single numerical score, several parameters such as walking speed, step length, and step width. The FAPS is commonly used for clinical evaluations, but its use is sometimes distorted by misunderstandings of its composition and calculation, practical and/or conceptual limits, and even the meaning of the score. This technical report reviews the use of the FAPS for the evaluation of gait and addresses important issues regarding clinical use and experimental design.

<http://dx.doi.org/10.1682/JRRD.2013.09.0198>

**Homeless and nonhomeless VA service users likely eligible for Medicaid expansion**

Jack Tsai, PhD; Robert A. Rosenheck, MD

The Affordable Care Act (ACA) introduces the state option to expand Medicaid, which may offer new health coverage options for U.S. veterans. This study used administrative data from the Department of Veterans Affairs (VA) to conservatively estimate that about 64 percent of homeless VA service users and 30 percent of nonhomeless service users are likely eligible for the Medicaid expansion. Those who are eligible for the Medicaid expansion have various medical and mental health needs, which may be complicated by cross-system use of VA and Medicaid-funded services. Therefore, the VA should carefully inform clinicians and patients about impli-

cations of the ACA and consider opportunities for coordinating care with outside providers.

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**Enhancing the well-being of veterans using extended group-based nature recreation experiences**

Jason Duvall, PhD; Rachel Kaplan, PhD

Physical and mental health issues are challenging for many veterans. We studied the use of extended group-based nature recreation to help veterans cope with these issues. Veterans were surveyed 1 week before, 1 week after, and about 1 month after participating in an outdoor recreation program. Participants reported increased psychological well-being, social functioning, and life outlook 1 week after the experience and some improvements persisted over the next month. These changes were particularly strong for veterans reporting more severe ongoing health issues. Findings suggest that extended nature recreation experiences that bring veterans together can have significant positive effects.

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**Glasgow Coma Scale scores, early opioids, and 4-year psychological outcomes among combat amputees**

Ted Melcer, PhD, et al.

Previous research showed that combat amputees were less likely to develop posttraumatic stress disorder (PTSD) than nonamputees. We tested the possibility that loss of consciousness or provision of pain medicine (morphine or fentanyl) soon after injury might prevent PTSD. We followed psychological diagnoses in military and Department of Veterans Affairs hospital records for 258 combat amputees for 4 years.

PTSD was less likely for patients treated with morphine than for patients treated with fentanyl, but only for 2 years after injury. Overall, PTSD cases increased over the first 4 years after injury, compared with other psychological diagnoses, such as depression.

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### **Design and evaluation of prosthetic shoulder controller**

Joseph E. Barton, PhD; John D. Sorkin, MD, PhD

The human humerus possesses three degrees of freedom (DOFs) with respect to the glenohumeral joint: flexion-extension, abduction-adduction, and internal-external rotation. Artificial limbs made for people who have lost their anatomical arm at or near the shoulder have historically not been able to perform these motions, greatly limiting their usefulness to people with amputation. We developed a prototype that uses the motion of the sternoclavicular joint along its two DOFs (protraction-retraction and elevation-depression) to produce signals that can be used to control two of a prosthetic humerus' DOFs, as well as an evaluation protocol to assess the performance of a prosthetic arm in reaching and pointing tasks.

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### **Canadian Occupational Performance Measure performance scale: Validity and responsiveness in chronic pain**

Mieke G. Nieuwenhuizen, MSc, PT, et al.

The Canadian Occupational Performance Measure (COPM) is a generic, individualized, patient-centered outcome measure and might be of aid to enhance communication about problems in participation and for goal setting in rehabilitation in any population. Therefore, this instrument can be of use in Department of Veterans Affairs rehabilitation as well. We have investigated the validity and responsiveness of this instrument in a broad population of

patients with chronic pain in whom psychological factors are important maintaining factors. Chronic pain and psychological suffering are more prevalent in veterans, and our results might be applicable for this population. In our study, construct validity of the COPM performance scale was not confirmed. No indication was found that the COPM performance scale can detect changes in occupational performance.

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### **Feasibility of closed-loop controller for righting seated posture after spinal cord injury**

Julie O. Murphy, BSE, et al.

Paralysis of the hip and trunk muscles after spinal cord injury can compromise the ability to maintain an upright sitting posture. This study determined the performance of a system that detected forward trunk tilt and stimulated the hip and trunk extensors to restore erect sitting automatically. The controller enabled users to lean forward and return with significantly less effort than with no stimulation. This research is important for many paralyzed veterans who would otherwise be unable to reach forward with both hands or who rely on straps or belts to prevent falling forward in their wheelchairs.

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### **Stability analysis of electrical powered wheelchair-mounted robotic-assisted transfer device**

Hongwu Wang, PhD, et al.

The ability of people with disabilities to live in their homes and communities with maximal independence often hinges, at least in part, on their ability to transfer or be transferred by an assistant. An easy-to-use system for assisting with transfers, attachable to electrical powered wheelchairs (EPWs) and readily transportable, could have a significant positive effect on the quality of life of people with disabilities. This study investigated the stability of our newly developed Strong Arm, which is attached and integrated

with an EPW to assist with transfers. The stability of the system was analyzed and verified by experiments applying different loads and using different system configurations. Our modeling accurately predicts the stability of the system and is suitable for developing better control algorithms to enhance the safety of the device.

<http://dx.doi.org/10.1682/JRRD.2013.11.0240>

**Development of intelligent model for personalized guidance on wheelchair tilt and recline usage for people with spinal cord injury: Methodology and preliminary report**

Jicheng Fu, PhD, et al.

Veterans with spinal cord injury (SCI) are at great risk for pressure ulcers because of their prolonged stays in wheelchairs. Wheelchair tilt and recline functions are two of the most desirable features for relieving seating pressure to reduce risk of pressure ulcers. In this study, we demonstrated the feasibility of using machine learning techniques to construct an intelligent model to provide personalized guidance on wheelchair tilt and recline usage for people with SCI. Our intelligent model considers individuals' demographic, neurological, and SCI injury attributes. Veterans with SCI may benefit from this intelligent model for selecting suitable tilt and recline settings.

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**Pushrim biomechanical changes with progressive increases in slope during motorized treadmill manual wheelchair propulsion in individuals with spinal cord injury**

Dany H. Gagnon, PT, PhD, et al.

The use of a motorized treadmill to assess and train manual wheelchair propulsion has gained great popularity over the past few years. Little is known about the effects of increasing the slope on the force applied at the pushrim. This study assessed the ef-

fects of five different slopes on the force applied with the nondominant hand on the pushrim during manual wheelchair propulsion on a motorized treadmill at a constant speed in individuals with a spinal cord injury. In general, these individuals grabbed their pushrim faster with their hand between strokes and applied greater forces on the pushrim as the slope of the treadmill increased during manual wheelchair propulsion.

<http://dx.doi.org/10.1682/JRRD.2013.07.0168>

**Passive prosthetic ankle-foot mechanism for automatic adaptation to sloped surfaces**

Eric Nickel, MS, et al.

Persons with amputation of a leg often have difficulty walking on sloped or uneven surfaces. Some microprocessor-controlled prosthetic ankle-foot systems are able to adapt their alignment to a surface slope over several steps, but a better system would be capable of adapting fully on every step without batteries and electronic systems. This article describes the development and initial testing of a passive mechanical prosthetic ankle-foot system designed to automatically adjust its alignment on every step of walking.

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**Effect of low-intensity direct current on expression of vascular endothelial growth factor and nitric oxide in diabetic foot ulcers**

Mohammad Reza Mohajeri-Tehrani, MD, et al.

Diabetic foot ulceration is an important complication of diabetes. These ulcers are long-lasting open sores that are hard to heal because of poor blood circulation at the wound site. We studied how electrical stimulation affected levels of vascular endothelial growth factor and nitric oxide in the plasma of type 2 diabetic patients with foot ulceration. Electrical stimulation was delivered for 1 hour a day, 3 days a week,

for 4 weeks (12 sessions total). Vascular endothelial growth factor and nitric oxide levels were significantly higher after the 12 sessions in the group who received electrical stimulation compared with an untreated group. Skin temperature increased significantly more in the electrical stimulation group than the untreated group. Application of electrical stimulation increases the expression of vascular endothelial growth factor and nitric oxide, which may improve blood flow, tissue temperature, and wound healing in patients with diabetic foot ulceration.

<http://dx.doi.org/10.1682/JRRD.2013.08.0174>

### **Extraction of spatial information for low-bandwidth telerehabilitation applications**

Kok Kiong Tan, PhD, et al.

We developed a method for extracting spatial data from a 2-dimensional video screen to substitute for 3-dimensional requirements in a low-bandwidth telerehabilitation system. This could help whenever spatial resolution is required in a consultation session, because 3-dimensional video files are often too large to transmit. We used Microsoft's Kinect together with color detection algorithms to extract the

depth information of the human body parts. No sensors need to be attached to the body for successful implementation of this system.

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### **Intrinsic transient tracheal occlusion training and myogenic remodeling of rodent parasternal intercostal fibers**

Barbara K. Smith, PhD, PT, et al.

This research has clinical implications for patients with weak respiratory muscles and dyspnea (shortness of breath). A rat model was used to identify fiber hypertrophy and regeneration in the parasternal intercostal muscles after 2 weeks of respiratory muscle training. The exercises increased parasternal fiber size equally and regeneration to a greater extent than the diaphragm. This work adds to our understanding of the cellular mechanisms by which respiratory muscle training improves muscle function. These findings may help providers prescribe to their patients the best type, frequency, and duration of exercise to improve inspiratory muscle function.

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