



New VA Career Development Award

Dr. Jon Pearlman, our Associate Director of Engineering, received a VA-funded Career Development award in October to study the risk of vibration exposure during wheelchair propulsion. The specific aim of this 2-year study is to gather long-duration vibration doses on the seat-bottom, seat-back and foot-rest of wheelchair users in different frame designs, and determine if there is a correlation between these vibrations and user neck pain. Dr. Pearlman and his co-investigators hypothesize that frame design (rigid, folding, and suspension) will have a significant effect on the vibration dose at the seat bottom and footrest when controlled for activity level.

For two weeks, the researchers will record the vibrations wheelchair users are exposed to during their daily activities with a wheelchair-

mounted vibration datalogger and activity monitor. They will also record information about their wheelchairs (type of cushion, backrest, and frame style). Participants will take a neck pain questionnaire at the beginning and the end of the study. Researchers will use the data to see if the recorded vibration correlates with reported user neck pain.

This work could lead to important advances in seating and suspension systems, which should reduce the deleterious effects of vibrations during wheelchair propulsion and improve wheelchair users' health.

-Christine Heiner

INSIDE THIS ISSUE:

| | |
|---|-----|
| Research Abstracts | 2-4 |
| Awards and Accomplishments | 5 |
| Meet the HERL Technical Staff | 6 |
| Agency Spotlight/ Upcoming events & Announcements | 7 |
| HERL Publications HERL in the News | 8 |

VA Kicks Off 2011 Pittsburgh NVWG

The VA Pittsburgh Healthcare System kicked off preparations for the 2011 National Veterans Wheelchair Games (NVWG) with a series of picnics at their 3 hospitals (University Drive, Highland Drive, Heinz) in October. HERL joined 2011 NVWG Chair Bill Leuthold and staff from VA volunteer and canteen services to publicize the event and encourage VA employees and visitors to get involved.

HERL set up a "mini-slalom" at the picnics to give visitors a taste of the NVWG athletic events. A slalom is a challenging obstacle course where wheelchair athletes navigate up and down steep inclines, through doorways, over rough terrain, and through mazes, testing their strength, speed, and coordination. VA employees visiting the picnics were eager to try



Top: HERL volunteer Sasha Stankovic and 2011 NVWG Chair Bill Leuthold serve food and spread the word about the 2011 Games. Bottom: VA Employee James Deakings tries the mini-slalom.

HERL's mini-slalom, using a wheelchair to navigate both forwards and backwards through a small driving course.

The VA and Paralyzed Veterans of America (PVA) are recruiting volunteers and sponsors for the 2011 Games. Here's how to get involved:

Volunteer Contact: Karen Cinnamon (412) 822-3096
Karen.Cinnamon@va.gov

Sponsorship Contacts: Patrick Doyle,
Patrick.Doyle@va.gov
412-954-4627

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-Christine Heiner

CURRENT RESEARCH ABSTRACTS

Real-time Model-based Electrical Powered Wheelchair Control

Hongwu Wang, MS, Benjamin Salatin, BS, Garrett G. Grindle, MS, Ding Dan, PhD and Rory A. Cooper PhD
Full Paper published in *Medical Engineering and Physics*, pp. 1244-1254, Vol. 31, No. 10, December 2009.

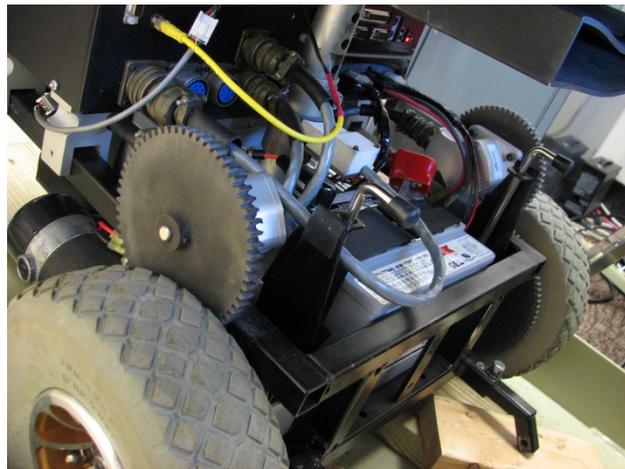
Purpose of Work: Control algorithms for electrical powered wheelchairs have not improved substantially since the early 1980s. The purpose of this study was to evaluate the effects of three different control methods on driving speed variation and wheel-slip of an electric-powered wheelchair (EPW).

Subjects/Procedures: A focus group was conducted to identify control strategies employed by EPW users. A kinematic model as well as 3-D dynamic model was developed to control the velocity and traction of the wheelchair. A smart wheelchair platform was designed and built with a computerized controller and encoders to record wheels speeds and to detect the slip. A model based, a proportional-integral-derivative (PID) and an open-loop controller were applied with the EPW driving on four different surfaces at three specified speeds. The speed errors, variation, rise time, settling time and slip coefficient were calculated and compared for a speed step-response input.

Results: Experimental results showed that model based control performed best on all surfaces across the speeds.

Relevance: Electric-powered wheelchair driving could become safer, more effective in a broader array of environments, and functional for more people with the application of advanced control systems.

-Hongwu Wang, MS



Electric powered wheelchair encoders built at HERL and used to record wheel speed and detect wheel slip in this study

Prostheses and Wheelchair Use in Veterans with Lower Limb Amputation

Amol M. Karmarkar, MS; Diane M. Collins, PhD; Todd Wichman, MD; Allison Franklin, DO; Shirley G. Fitzgerald, PhD; Brad E. Dicianno, MD; Paul F. Pasquina, MD; Rory A. Cooper, PhD.
Full article published in *Journal of Rehabilitation Research and Development*, pp. 567-576, Vol. 46, No. 5, 2009.



Purpose of Work: The objective of this project was to determine if demographics and health-related characteristics contribute to the selection of, and satisfaction with, either wheelchair or lower limb prosthesis use among veterans with lower limb amputation.

Subjects/Procedures: Forty-two veterans with lower limb amputation who attended either the 20th

National Disabled Veterans Winter Sports Clinic, Snowmass CO, or the 26th National Veterans Wheelchair Games, Anchorage, AK, participated in this study. Participants had to be 18 years of age or older, have a lower limb amputation, and use a mobility device such as a wheelchair or prosthesis. Partici-

pants identified themselves as either primary users of wheelchairs or prostheses.

Results: Level of lower limb amputations was the most significant health-related characteristics determining whether a veteran would choose to use a wheelchair versus prosthesis for mobility. For functional performance, veterans using prostheses with high amputation levels reported significantly more difficulty walking up a ramp; getting in/out of car/bus; shopping; and while participating in sports activities. Satisfaction related to prostheses was not a determinant factor for making a selection between mobility devices.

Relevance: Interaction between utilization of prostheses and changing needs should be determined on a long term basis. This could suggest more viable alternatives, which could not only improve participation but, in long-term, have a positive impact on quality of life of those with lower limb amputation.

-Amol Karmarkar, PhD

CURRENT RESEARCH ABSTRACTS

Manual Wheelchair Propulsion Patterns on Natural Surfaces

Alicia M. Koontz, PhD, RET; Bailey M. Roche; Rachel Cowan, PhD; Jennifer L. Collinger, PhD,
Rory A. Cooper, PhD, Aaron Souza, PhD, Michael L. Boninger, MD

Full article published in *Archives of Physical Medicine and Rehabilitation*, pp. 1916-1923, Vol. 90, No. 11, November 2009.

Purpose of the Work: Research has shown that using propulsion techniques that minimize forces and stroke frequency as well as customizing the setup of the wheelchair could potentially reduce the onset and severity of repetitive strain injuries. The aims of this study were to classify propulsion patterns over natural surfaces and to compare selected biomechanical variables between pattern types.

Subjects/Procedures: Twenty-nine manual wheelchair users at the National Veterans Wheelchair Games in Minneapolis, MN in 2005 volunteered for the study. They each propelled their own wheelchair over sections of high-piled carpet, linoleum, and up a ramp with a five degree incline. Propulsion techniques were recorded using a 3D motion capture system and an instrumented wheel. Five researchers classified stroke patterns into one of four types: arc, semi-circular (SC), single-looping (SL) and double-looping (DL) on each surface. Biomechanical variables were calculated and compared between pattern types.

Results. The arc pattern was used more often than the other patterns on all surfaces. On linoleum, participants who dropped their hand beneath the pushrim during recovery had smaller propulsive forces compared to the SL pattern and a tendency for

a lower stroke frequency compared to participants who used the arc pattern. Individuals who pushed with an arc pattern went slower than individuals using other patterns on the ramp.

Relevance: A majority of manual wheelchair users in this study were found to use an arc pattern of propulsion; however, using a pattern where the hand drops beneath the arc of the pushrim during recovery was found to correspond with a lower stroke frequency and lower propulsion forces on level ground. Thus, it follows that using this type of pattern may minimize the risk of developing repetitive strain injuries from wheelchair use. Our study also suggests that there may be advantages to using a non-arcing form of propulsion on the ramp as well.

-Alicia Koontz, PhD



Ultrasonographic Median Nerve Changes After a Wheelchair Sporting Event

Bradley G Impink, BS, Michael L Boninger, MD, Heather Walker, MD, Jennifer L Collinger, PhD

Full article published in *Archives of Physical Medicine and Rehabilitation*, pp. 1489-1494, Vol. 90, No. 9, September 2009.

Purpose of the Work: Carpal tunnel syndrome, which involves the median nerve at the wrist, is common amongst manual wheelchair users. In this study we sought to investigate the response of the median nerve to intense wheelchair propulsion using ultrasound and to examine the relationship between the median nerve response and carpal tunnel syndrome (CTS) signs and symptoms

Participants/Procedures: Twenty-eight manual wheelchair users competing in wheelchair basketball at the National Veterans Wheelchair Games answered questionnaires, had a physical examination of the hands and wrists, and had ultrasound images of the wrist taken before and after a wheelchair basketball game.

Results: Significant changes in median nerve

ultrasound characteristics were seen after activity. Individuals with positive physical examinations showed significant changes in median nerve size compared to no significant change in the normal group. Individuals with CTS symptoms had a significantly greater duration of wheelchair use (17.1 years) compared to the asymptomatic participants (9.0 years).

Relevance: Manual wheelchair propulsion causes immediate changes in median nerve characteristics which can be seen using ultrasound. Studying the median nerve response may be useful for optimizing things such as wheelchair set up or propulsion training, which could decrease both immediate and long term median nerve damage and the likelihood of developing CTS.

-Brad Impink, BS

CURRENT RESEARCH ABSTRACTS

Wheelchair Repairs, Breakdown and Adverse Consequences for People With Traumatic Spinal Cord Injury

Laura A. McClure, MPT, Michael L. Boninger, MD, Michelle L. Oyster, MS, Steve Williams, MD, Bethlyn Houlihan, MSW, MPH, Jesse A. Lieberman, MD, Rory Cooper, PhD

Full article published in *Archives of Physical Medicine and Rehabilitation*, pp. 2034-2038, Vol. 90, No. 12, Dec. 2009.

Objectives: To observe the frequency of repairs that occurred in a six month period and the results of breakdowns on wheelchair users living with spinal cord injuries (SCI). Wheelchair and subject characteristics were examined to determine if certain characteristics were associated with an increased number of repairs and adverse consequences, such as being stranded, having to cancel a medical appointment, getting injured, or missing work or school.

Methods: 2213 people with SCI who use a wheelchair for over 40 hours per week took a survey collecting information about the frequency of repairs to their wheelchairs and adverse consequences caused by wheelchair breakdowns during a 6 month time period.

Results: 44.8% of full time wheelchair users completed a repair within a 6 month period of time and 8.7% had an adverse consequence occur. People who

use power wheelchairs required significantly more repairs ($p>0.001$), and adverse consequences occurred more frequently ($p>0.001$) compared to manual wheelchair users. The presence of power seat functions, and an individual's occupational status or gender did not influence the number of repairs or adverse consequences.

Relevance: Frequent repairs and breakdown can negatively impact an individual's life by decreasing community participation and threatening health and safety. Mandatory compliance with American National Standards Institute (ANSI) and the Rehabilitation Engineering and Assistive Technology Society of North America (RESNA) standards, changes in insurance reimbursement policy and patient and clinician education are necessary to reduce the number of repairs and adverse consequences that occur.

-Laura McClure, MPT

VAPHS Volunteer Services

The face of today's healthcare volunteer has changed dramatically from the candy striper of the 50's and 60's. Today's healthcare volunteers are men, women, and youth dedicated to the mission of the healthcare environment they choose to support, and they are often searching for avenues to fulfill their own desires and dreams of becoming a healthcare professional. It takes more than a spotless GPA to get into medical school today. Admissions boards are looking for applicants who have demonstrated commitment through volunteerism, special projects and job shadowing experiences. Nursing schools have become increasingly selective, choosing students who have volunteered time in a healthcare environment.

The VA Pittsburgh Healthcare System (VAPHS) is eager to assist students as they advance their journey into healthcare by offering high quality, ongoing opportunities for volunteerism. Many volunteer opportunities are available in each of the VAPHS' three hospitals. VAPHS Volunteer Services is proud of their commitment to training the future providers of healthcare to America's Heroes, our Veterans. If you are interested in finding an exciting opportunity to volunteer with the VA Pittsburgh Healthcare System, contact one of our Voluntary Offices today—by phone at 412-822-3096 or by e-mail: Karen.Cinnamon@va.gov. More information is also available online at <http://www.pittsburgh.va.gov/voluntary/index.asp>.

New VA Center Guest Lecture Series

The HERL VA Center for Wheelchairs and Associated Rehab Engineering started a new lecture series this fall as part of our continuing education efforts. Our monthly lectures will feature various speakers from both inside as well as outside HERL to introduce attendees to the latest developments in research related to helping people with disabilities.

Our first two lectures featured "Accessible Transportation" by Aaron Steinfeld from Carnegie Mellon University, and "E-Mentoring" by Romy Banks and Joel Moore at Smart Futures. Laurel Person Mecca and David Halpern from the University of Pittsburgh Center on Social and Urban Research will speak about "Qualitative Analysis and Research Services" at our next lecture on January 11, 2010.

Continuing education credits are offered to WaRE lecture series attendees; lectures are open to any Pittsburgh-area or visiting researcher or student who is interested.

If you would like to receive announcements about future lectures in the WaRE lecture series, please contact Ron Wesolowski at 412-954-5287 or row25@pitt.edu.

Awards and Accomplishments

The Veterans' Leadership Program of Western PA awarded our director **Rory Cooper, Ph.D.** with the 2009 "Veteran of the Year" award. Dr. Cooper also received Keystone Paralyzed Veterans of America's "Sports Award" at their annual banquet, as well as United Cerebral Palsy of Pittsburgh's "Community Hero" award.



Dr. Rory Cooper received the "Veteran of the Year" award from the Veterans' Leadership Program of Western PA on October 29.

News From the University of Pittsburgh Department of Physical Medicine and Rehabilitation

On Nov. 17th, Max Starks of the Pittsburgh Steelers and the UPMC Institute for Rehabilitation and Research (IRR) joined to host "Gridiron Gaming", a fundraiser to help the IRR develop wellness programming for people with physical disabilities and to announce the establishment of the IRR's gaming and robotics center. Attendees explored IRR's cutting-edge rehab technology and competed against Steelers players in games of Nintendo Wii, the popular video game system that also serves as a fun rehab tool at the IRR. Guests and patients bowled against Chris Kemoeatu and Trai Essex, challenged Deshea Townsend and Ryan Clark to a game of basketball, and faced off against Limas Sweed, Hines Ward, James Farrior, Darnell Stapleton, Justin Hartwig at various other games.



Garrett Grindle

Garrett Grindle, MS was awarded the Tom O'Connor Scholarship, a \$500 award given to an exemplary PhD student in the University of Pittsburgh's Department of Rehab Science and Technology (RST) for their commendable efforts. Garrett has been working at HERL since 2002, first as an undergraduate and later as a grad student, and has demonstrated incredible enthusiasm and leadership throughout his educational career. Garrett is co-chair of the Quality of Life Technology Student Leadership Council and leads the student mentors in Tech-Link program's FIRST (For Inspiration and Recognition of Science and Technology) LEGO League (FLL) robotic camp sessions. The camps are targeted towards middle school students with and without disabilities, girls, and minorities with the goal of inspiring interest in science and technology. Each year the teams compete in FLL regional competitions. In this year's December 5th competition, one of the Tech-Link teams won the first place robot design award. Garrett and fellow HERL graduate students **Brad Impink, Ben Salatin, Hongwu Wang, Nahom Beyene, and Lynn Worobey** mentored this year's Tech-Link teams.

Pallavi Sood was awarded the Sean and Stephanie Shimada Award, a \$500 scholarship given to a new RST graduate student demonstrating a strong interest in the field.



IRR Director and HERL Medical Director Dr. Michael Boninger with the Pittsburgh Steelers at Gridiron Gaming

News From the University of Pittsburgh Department of Rehab Science and Technology (RST)

Pitt's School of Health and Rehabilitation Sciences was awarded a five-year \$4,750,000 million grant from the National Institute on Disability and Rehabilitation Research to continue its innovative Rehabilitation Engineering Research Center on Telerehabilitation (RERC-TR). The only research center of its kind, the RERC-TR will apply Informatics technology to develop an accessible, scalable, cost-effective, open, extensible and secure infrastructure to connect service providers, rehabilitation applications and consumers. A main emphasis of the center will be to investigate the value and effectiveness of rehabilitation services delivered in consumer homes, workplaces and communities.

Meet the HERL Technical Staff

Our technical staff form a unique team of experts who support our machine shop and electronics lab. These labs span over 3,000 square feet and house the resources for the development and testing of designs, fabrications and prototypes for our research projects.



Jonathan Pearlman, PhD, is supervisor for the technical staff as well as Associate Director of Engineering. Once a HERL graduate student, Dr. Pearlman now oversees design and manufacturing of parts and assemblies to support the needs of other researchers as

well as his own funded research projects. Jon's guidance and creative scientific contributions with developing research projects are invaluable.

Zachary Mason, MSE is a mechanical engineer who manages the machine shop staff on a daily basis. Zach's expertise is with our rapid prototyping



equipment (Selective Laser Sintering/Convection Oven and Stereo Lithography Apparatus) and our material testing equipment used to evaluate assistive devices. Zach is always eager to review design or provide guidance and teach others to use these machines.



Stephen Hayashi, BS, an electronics engineer, is responsible for our advanced computer-driven prototyping capabilities, including a Computerized

Numerically Controlled Mill and Lathe and a Wire Electro-Discharge Machine. He also assists researchers with the design and layout of circuit boards, choosing electronic components, data collection and data analysis.

Mark McCartney is a senior machinist with 30 years experience, including domestic and international field service. Mark runs our machining equipment, including the milling machines and



lathes which are used for complex shaping of metal and other materials. Mark is also a Machinist for the Center for Assistive Technology (CAT) at the University of Pittsburgh Medical Center. In addition to mastering machines, Mark also has extensive experience with assistive technology. He provides our graduate students expert instruction for their research projects.



Benjamin Gebrosky, BS, is a mechanical engineer and the newly appointed wheelchair testing engineer. Ben applies "wheelchair standards" to validate the

designs of our research projects as well as evaluate mobility devices already on the market or about to be released. Wheelchair standards are detailed test and measurement methods designed to create consistent information about the features and performance of wheelchairs. Ben also oversees our welding equipment in the machine shop.

The combined unique talents of the HERL technical staff provide invaluable support of the majority of our research studies.

-Andrea Bagay

Agency Spotlight

Unemployment is one of the most profound issues facing persons with disabilities in the United States today. Long before the fall of our economy last year the rate of unemployment among people with disabilities was 65%.

Because of unemployment, a disproportionate amount of individuals with disabilities are more likely to live in poverty than the average American.

The mission of Project for Freedom is to provide technology skills and customer service training and to assist in gaining competitive employment opportunities for qualified individuals with disabilities.

The organization is a 501 (c) (3) nonprofit started in 1998. The training program that it offers provides focused skills training plus job placement for qualified persons with disabilities facilitating the transition to full-time competitive employment and economic self-sufficiency. It enables people with disabilities to become productive, contributing members of society and to regain the dignity that comes from supporting themselves and their families.

Project for Freedom has developed partnerships with local businesses and organizations that include: OVR (Office of Vocational Rehabilitation), Milestone, Career Development Center, Careerlink, Highmark, Bayer Corporation, Bender Consulting Services, UPMC, Comcast, Dress for Success, Philip Pelusi Hair Salon, and others. Project participants become familiar with the PA State Careerlink system that provides them with the resources to do job searches and provides workshops to improve job search skills.

Students qualify for a new innovative internship program at Bayer Corporation that is available only for people with disabilities. The paid internship lasts one year and provides employee benefits. Students may be hired at the end of the year, or if not, Project for Free-



dom helps them to find placement and they still gain the valuable experience of working at a large international company that they can add to their resume.

This September a graduate from Project for Freedom was one of the first applicants accepted in the Bayer internship program.

Partnering with Community College of Allegheny County, Project for Freedom recently added a Medical terminology component to the curriculum that supplements the customer service training that is provided and helps to increase the employability of students applying for employment at places like hospitals and medical insurance companies.

Project for Freedom is the ONLY organization in the region that provides technology and professional skills training to people with disabilities AND works with them to find job placements. They are addressing the problem of extremely high unemployment rates among people with disabilities. Project for freedom provides the skills they need to compete in the workforce and helps them to get their "foot in the door" with employers.

Project for Freedom is located at 1323 Forbes Avenue in Pittsburgh, which is on a major bus line in a building that is totally accessible.

For additional information about the program, contact Coleen Vuono at vuono@projectforfreedom.org, visit www.projectforfreedom.org, or call (412) 246-4434.

Events and Announcements

The HOPE Network is looking for both participants as well as volunteers for their Healthsports Ski Classic on January 25-27, 2010. This yearly adaptive snow-ski event for people with disabilities is held at Hidden Valley Ski Resort in the Laurel Mountains of Southwestern PA (about 60 miles from Pittsburgh).

To become a participant or a volunteer, or for more general information about the Healthsports Program call (412) 826-2703 or email at hsports@city-net.com. The registration deadline for both skiers and volunteers is January 10, 2010.





Human Engineering Research Laboratories



VA Center Of Excellence For Wheelchairs and Associated Rehabilitation Engineering



University of Pittsburgh NIDRR Model Center on Spinal Cord Injury



Part of
Quality of Life Technology Center
a National Science Foundation Engineering Research Center

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E-mail any comments, corrections, or questions concerning the newsletter to the editor, Christine Heiner at:

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HERL PUBLICATIONS

Karmarkar AM, Collins DM, Wichman T, Franklin A, Fitzgerald SG, Dicianno BE, Pasquina PF, Cooper RA, Prostheses and Wheelchair Use in Veterans with Lower Limb Amputation, **Journal of Rehabilitation Research and Development**, pp. 567-576, Vol. 46, No. 5, 2009.

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Simpson R, Using the Speed-Accuracy Operating Characteristic to Visualize Performance with Pointing Devices, **The Open Rehabilitation Journal**, pp. 58-63, Vol. 6, No. 2, 2009.

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HERL IN THE NEWS

American Adventure Sports, March 16, 2009: [Veterans Challenge](#)

Sports 'N' Spokes, p. 6, September 2009: Great Games

Carnegie Mellon University Robotics Institute Website, September 2009: [Australian Prime Minister Visit](#)

Pittsburgh Business Times, October 5, 2009: [Michael Boninger Named to Post at Pitt School of Medicine](#)

Pitt Chronicle, October 12, 2009: [Awards and More: Rory Cooper](#)

KDKA, October 15, 2009: ["A Tribute to Veterans" Honors Local Heroes](#)

University Times, October 15, 2009: [People of the Times: Michael Boninger & Rory Cooper](#)

Pittsburgh Tribune Review, October 18, 2009: [Newsmaker: Dr. Michael Boninger](#)

Pittsburgh Tribune Review, October 19, 2009: [Newsmaker: Rory Cooper](#)

McGowan Institute for Regenerative Medicine (MIRM) Newsletter, November 2009: [State of the Science Workshop: Regenerative Rehabilitation](#)

Pittsburgh Post Gazette, November 3, 2009: [Veterans 2009 Partners in Leadership Awards at Carnegie Music Hall](#)

Stripe, November 20, 2009: Regenerative Medicine no Longer Futuristic

The Parascope, p. 1-3, November/December 2009: Chapter Recognizes Top Achievers at Banquet. P. 6: Rich Simpson Receives KPVA Award. P. 12: PerMMA at G20 Summit

UPMC News Bureau, December 15, 2009: [Pitt Study Shows Wheelchair Breakdowns Common and Cause Problems for Spinal-Cord Injured Users](#)

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