ABSTRACTS –ACQUIRED BRAIN INJURY & SOCIETY TEAM (1-8)

Team Leader: Dr. Angela Colantonio

The Acquired Brain Injury (ABI) & Society team is a global leader in research that addresses the intersection of social variables and brain injury, such as sex/gender, socioeconomic status, workplace cultures, and criminalization. Thus, much of their research explores the impact of brain injury on marginalized and vulnerable populations. They are developing strategies to improve the planning, delivery, and outcomes of health services that integrate personal and social/systemic factors with the latest scientific evidence.

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1. Financial Management Skills Assessments Often Lack Adequate Evidence for Use: A Systematic Review

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Introduction: Financial management skills are integral to adults' independence and participation in meaningful activities, but clinicians are often unsure how to best assess this area.
Objectives: To critically analyze the psychometric evidence of select financial management skills instruments and provide evidence-based recommendations about financial management skills assessment.
Methods: Using five databases, two reviewers conducted a systematic review of the psychometric evidence for eight observation-based performance financial management skills instruments. Studies were assessed for their quality as well as their results.
Results: Of the eight measures, the Financial Competence Assessment Inventory (FCAI) is the only instrument that is clinically available and contains four or more financial management skills subscales. We found only two studies about FCAI reliability or validity. The reliability evidence is of poor quality and the validity evidence is of fair quality. The validity results indicate that the FCAI can discriminate between people using and not using a financial guardian.
Conclusions: There is limited high-quality psychometric evidence for the eight most-comprehensive observation-based performance instruments. The FCAI validity evidence should be interpreted with caution considering there is a dearth of high-quality reliability evidence. More psychometric evidence research for financial management skills assessment instruments is needed.

2. Predicting Cognitive Outcome in TBI Using a Brief Neurocognitive Battery

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1 Toronto Rehabilitation Institute; 2 University of Toronto - Rehabilitation Sciences Institute

Introduction: Cognitive screening is performed during initial care to prognosticate outcomes in TBI. The best predictive model likely involves patient, clinical, and cognitive factors. The Cogstate Brief Battery™(CBB) is a brief electronic assessment tool with four tasks (Detection, Identification, One-Card Learning, and One-Back) that provides measures of psychomotor speed, attention, visual learning and memory, and working memory.
Objectives: To determine the utility of the CBB as an early prognostic tool in a TBI inpatient sample while controlling for demographics and injury severity.
Methods: Individuals with TBI were recruited at the Toronto Rehabilitation Institute. Hierarchical linear regression was used to predict functional outcome at discharge from inpatient rehabilitation measured by the cognitive subscale of the Functional Independence Measure (Cog-FIM); predictors included demographic variables in the first step, clinical indicators in the second step, and scores on the CBB in the final step.
Results: The model was significant (R^2 [13, 37] = 0.66, $p < 0.001$): education ($\beta = 0.26$), GCS category ($\beta = -0.27$), length of stay in days ($\beta = -0.35$), and One-Back variability ($\beta = -0.35$) predicted Cog-FIM scores at discharge. Results support previous research that demographics, clinical and cognitive factors may be useful prognosis of TBI.

3. Modeling Community Integration of Workers with Delayed Recovery from Mild Traumatic Brain Injury/Concussion

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Objective: To identify the factors associated with community integration among persons with delayed recovery following work-related mild traumatic brain injury (MTBI)/concussion.
Setting: A rehabilitation hospital in Ontario, Canada.
Participants: Ninety-four insured workers with MTBI (45.2±9.9 years old, 61.2% male) at 197 days post-injury (interquartile range, 139-416 days).
Design: A cross-sectional study. Community integration scores were compared using analysis of variance or Spearman's correlation tests. Stepwise multivariable linear regression models were used to evaluate the associations with community integration.
Main measures: Sociodemographic, occupational, injury-related, clinical, and claim-related data collected from self-report measures, medical assessments, and insurers' referral files. Community Integration Questionnaire (CIQ) measured perceived integration outcome.
Results: The CIQ total and subscale scores were similar to those reported in more severe TBI samples. The CIQ scores were moderately to strongly correlated with various sociodemographic, claim-related, and clinical variables.
Conclusions: Insomnia is a particularly relevant covariate of community integration after MTBI. The variables derived from our models can be tested in a prognostic modeling study estimating community integration of persons with MTBI.

4. Characterizing Workers Surviving Assault in Work-Related Traumatic Brain Injury and Exploring Impact on Return to Work: Analysis of Workers' Compensation Claims in Victoria, Australia

R Shafi1, 2, A Colantonio 1, 2

1 University of Toronto; 2 Toronto Rehabilitation Institute, UHN

The aim of this retrospective analysis was to explore the contribution of intentional TBI (assault) versus non-intentional TBI along with other factors (hospitalization, age and gender) on predictive ability to return to work. As per the Canadian literature, up to 10% of all TBI admissions are a result of physical assault. Given the substantial literature on the impacts of TBI on work related disability, we are interested in understanding the role that intentional TBI (assault resulting in TBI) has on the outcomes related specifically to return to work. The dataset utilized for this study constitutes claims made to WorkSafe Victoria (Australia) from 1986 to 2012. Descriptive statistics were computed by generating frequency distributions for categorical variables and calculating means, SD, medians and IQR for continuous variables. The Fisher's exact test was used to examine the significance of association between demographic and vocational variables of interest. A binary logistic regression approach was used to test the model. There is evidence to suggest that individuals who have sustained physical assault score significantly lower on scales measuring reintegration into normal life.

5. Work-Related Mild Traumatic Brain Injury in Ontario: Preliminary Quantitative and Qualitative Findings

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1 Toronto Rehabilitation Institute-UHN; 2 Ontario Network of Injured Workers; 3 Workers' Health and Safety Centre; 4 Infrastructure Health and Safety Association; 5 LAMP Community Health Centre; 6 Laurentian University

Objectives: To profile the demographic and injury characteristics of workers with mild work-related traumatic brain injury (wrTBI) and to explore the nature and causes of wrTBI from the perspective of injured workers through a qualitative analysis.
Methods: Cross-sectional study with prospective recruitment. Participants were recruited from an outpatient clinic to which they were referred for persisting symptoms related to brain injury. Participants (n = 47) completed a self-report questionnaire and/or an in-depth semi-structured qualitative interview (n = 30).
Results: 53.3% of study participants were male. On average, participants were 13.1 months post-injury (SD = 14.4). Further, 48.8% of participants were over 50 years of age. Mechanism of injury was distributed as follows: struck by/against object (39.1%), falls (34.8%), assault (15.2%), and other (10.9%). The education industry constituted the largest number of wrTBI (25.0%), followed by the manufacturing/warehousing (20.5%), retail (13.6%), and healthcare industries (11.4%). In-depth interviews identified a number of structural factors contributing to wrTBI: insufficient training, inattention to physical work environment conditions, and insufficient staffing.
Conclusions: The education sector is not typically regarded to be hazardous. Our findings suggest that prevention efforts need to focus on this sector. It is significant that identified causes of work-related injury are amenable to change.

6. Traumatic Brain Injury and Inpatient Rehabilitation: The Influence of Age

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Introduction: Inpatient rehabilitation is one of the main elements in the continuum of care in patients with TBI. Although numerous population-based studies were conducted on TBI patients, there is a lack of consensus on the impact of age on Canadian inpatient rehabilitation components.
Objectives: We sought to investigate the effect of age on inpatient rehabilitation components and functional outcomes in patients with TBI who were treated at TRI-UHN.
Methods: Data on 150 TBI patients (≥14 years) that were consecutively admitted to TRI-Inpatient Rehabilitation between 2008 and 2011, were obtained from Practice-Based Evidence project. Patients were stratified by their age into four sub-groups (≤30, 30-45, 45-65, and ≥ 65 years).
Results: Falling was the main cause of TBI in older patients. They had a longer length of stay (LOS) and longer time from injury to inpatient rehabilitation admission ($p \leq .05$); they received more intervention time from OT and PT but less from SLP. These amounts were not significantly different in comparison with other age groups. All groups showed significantly higher function at discharge from the inpatient rehabilitation program ($p \leq .05$).
Conclusion: Further analysis is warranted to examine the effect of comorbidity on length of stay and on differences in terms of type and intensity of activities in each discipline by age groups.

7. Assessment of Sex Analysis in Studies of Technology-based Interventions to Alleviate Caregiver Burden among Caregivers of Persons with Dementia

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Background: Caregiver burden is a major concern for caregivers of persons with dementia. While technology-based interventions can alleviate caregiver burden, there is little consideration of sex differences among caregivers in the design of these interventions.
Objective: To systematically review the literature on technology-based interventions for caregivers of persons with dementia and report the frequency and approaches of sex-based analysis.
Methods: The literature was systematically searched for reviews of technology-based interventions for caregivers of persons with dementia. Titles and abstracts of publications included in the retrieved reviews were screened using pre-determined inclusion and exclusion criteria. Results: Among the 17 retrieved studies, 16 included male and female caregivers. Only four studies examined outcomes by sex, of which three reported significant sex differences ($p < 0.05$).
Conclusions: There is currently a lack of (1) sex-based analyses, (2) inclusion of men and (3) provision of sex-specific information in studies of technology-based interventions for caregivers of persons with dementia.

8. Determinants of Admission to Inpatient Rehabilitation after Hypoxic Ischemic Brain Injury

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1 Toronto Rehabilitation Institute, University Health Network; 2 Rehabilitation Sciences Institute, University of Toronto; 3 Westpark Healthcare Centre

Objectives: To investigate determinants of admission to inpatient rehabilitation among hypoxic-ischemic brain injury survivors among a population-based Ontario cohort.
Methods: All patients aged 20 years and older with a hypoxic-ischemic brain injury in acute care following acute care discharge between April 2002 and December 2010 (N=593). Multivariable regression was used to estimate independent effects of predictors of admission to inpatient rehabilitation.
Results: Twenty-eight percent of hypoxic-ischemic brain injury survivors were admitted to inpatient rehabilitation following acute care discharge; 19.6% of survivors were transferred directly. Of patients admitted, 40.6% had a hypoxic-ischemic brain injury-associated admitting diagnosis; 56.7% received rehabilitation for non-traumatic acquired brain injury. In multivariable regression models, younger age, male sex, lower comorbidity burden, length of stay of preceding acute care episode and markers of delayed acute care discharge were most predictive of admission to inpatient rehabilitation. Women had an almost two-fold lower (RR: 0.65; 95% CI: 0.49-0.85) incidence of admission.
Conclusion: Older age, higher comorbidity burden, longer preceding acute care episode and delayed discharge from acute mark significant barriers to inpatient rehabilitation admission for hypoxic-ischemic brain injury patients. That women are almost two-fold less likely to receive rehabilitation treatment is alarming and requires further investigation.

ABSTRACTS –CARDIORESPIRATORY FITNESS TEAM (9 – 14)

Team Leader: Dr. Paul Oh

The cardiac research team focusses on the research & development and implementation science of an evidence-based non-pharmacological "pill" known as physical activity. Our team encompasses a unique multidisciplinary translational approach in our research designs and methodologies, which allow us to explore the interactive and modulating effects of physical activity across the brain, heart, and body and do so throughout the health continuum from disease prevention to disease management. Leveraging the largest living cardiac rehabilitation laboratory in Canada and one of the largest in the world, our program explores ways to individualize the dose, delivery mechanism, and kinetic properties of our evidence-based non-pharmacological therapy to optimize the health and outcomes of populations both within Canada and beyond.

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9. Evaluating the Relationship between Markers of Oxidative Stress and Depressive Symptomatology in Coronary Artery Disease Patients

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1 University of Toronto, Department of Pharmacology & Toxicology; 2 Toronto Rehabilitation Institute; 3 Sunnybrook Health Sciences Centre

Background: Depression is highly prevalent in patients with coronary artery disease (CAD). It is associated with poor compliance to cardiac rehabilitation and worse prognoses. Oxidative stress, particularly lipid peroxidation, is an emerging mechanism relevant to both cardiovascular and depressive etiopathology, but no studies have examined markers of oxidative stress in depression in CAD patients.
Methods: Depressive symptomatology was assessed with the self-administered Centre for Epidemiological Studies Depression Scale (CES-D). Four markers of lipid peroxidation (lipid hydroperoxides, 4-hydroxynonenal, malondialdehyde, and 8-isoprostane) were measured using spectrophotometric assays from serum samples provided by study patients.
Results: In patients with CAD (n=86, mean age=61.4±8.3, 76% male, mean BMI=28.5±5.1), it was found, using a general linear regression model, that higher log-transformed concentrations of 8-isoprostane, a marker of late-stage oxidative damage to lipids, were significantly associated with higher CES-D scores (adjusted: $R2=0.118$, $B^2=0.247$, $p=0.019$) after controlling for age, gender, and BMI. No such associations were found for lipid hydroperoxides, 4-hydroxynonenal, and malondialdehyde.
Significance: Oxidative stress may be an important indicator of depression in a CAD population. Further exploring the common mechanisms underlying depression and CAD may reveal relevant biomarkers of etiologic and prognostic value.

10. Evaluating the Relationship between Ceramides and Depressive Symptoms in Coronary Artery Disease Patients Undergoing Cardiac Rehabilitation

A Dinoff1,2,3, M Saleem1,2,3, W Swardfager1,2,3, N Herrmann3, P Oh2,3, K Lanctôt1,2,3

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Background: Depression is highly prevalent in individuals with coronary artery disease (CAD), and increases risk of dropout from cardiac rehabilitation (CR) and risk of future cardiac events. Ceramides, a family of sphingolipids, have been implicated in the pathophysiology of CAD and may be important in depression due to their pro-inflammatory and pro-apoptotic characteristics. Concentrations of ceramides were assessed as predictors of change in depressive symptoms in CAD subjects undertaking CR.
Methods: Depressive symptoms were assessed using the self-administered Centre for Epidemiological Studies Depression Scale (CES-D) before and after a 6 month CR program. Ceramide concentrations were measured from fasting blood samples using high performance liquid chromatography coupled electrospray ionization tandem mass spectrometry (LC/MS/MS). Repeated measures general linear models were used to assess the association between plasma ceramides and change in depressive symptoms over 6 months of cardiac rehab controlling for age, gender and BMI.
Results: In patients with CAD (n=38, mean age=64±7, 84% male, mean BMI=28±4), higher baseline plasma C16:1 ($F_{1, 33} = 5.23$, $p = 0.029$) concentration significantly predicted less improvement in depressive symptoms over 6 months of CR.
Conclusions: Plasma ceramide concentrations should be further examined as predictors of depressive symptom response to exercise interventions such as CR.

11. Assessment of Cardiovascular Reserve in HER2-Positive Breast Cancer Survivors

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1 University of Toronto; 2 Toronto Rehabilitation Institute, Cardiac Prevention and Rehabilitation Program; 3 University of British Columbia; 4 Memorial Sloan Kettering Cancer Center

Purpose: To examine cardiovascular reserve during incremental exercise to identify early markers of cardiovascular impairment in asymptomatic HER2-positive breast cancer survivors.
Patient and Methods: Eight HER2-positive breast cancer survivors (53.0 Â± 8.2 yr of age) were included in this investigation. Eight age-matched apparently healthy controls (54.6 Â± 9.6 yr of age) were also included. Participants underwent the following measures during incremental exercise: change in exercise haemodynamics (stroke volume, cardiac output, left ventricular volumes), ventricular-vascular coupling and its components (left ventricular elastance (ELV) and arterial elastance (Ea)) and peak aerobic power (VO2peak).
Results: VO2peak was similar between groups ($p = 0.28$). ELV index reserve was reduced in the breast cancer group compared to controls ($p = 0.009$). No between group differences were observed in the Ea index reserve ($p = 0.33$) or ventricular-vascular coupling index reserve ($p = 0.09$). There were no significant between group differences for stroke volume index reserve or cardiac output index reserve (all $p > 0.05$). End systolic volume reserve was significantly lower in the breast cancer group compared to the control group ($p = 0.03$).
Conclusion: In HER2-positive breast cancer survivors there are indicators of impairments in cardiac function during exercise conditions despite similar VO2peak.

12. Depressive Symptoms Predict Non-Adherence to Exercise-Based Rehabilitation for Participants with Type-2 Diabetes

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1 Toronto Rehabilitation Institute; 2 University of Toronto, Department of Pharmacology and Toxicology; 3 Sunnybrook Research Institute

Background: Exercise recommendations are infrequently adopted and adhered to by people with type 2 diabetes mellitus (T2DM). This study assessed the relationship between depressive symptoms and non-adherence to a structured exercise-based rehabilitation program for participants with T2DM.
Methods: Cohort study of participants with complete demographic, glycemic, exercise stress test and depression screening information at baseline. Depressive symptoms were screened using the Center for Epidemiological Studies Scale for Depression (CES-D). Attendance to on-site exercise sessions was monitored throughout a 6-month program, and completion or non-completion was recorded.
Results: Of the participants entering the diabetes program (Jan 2009 - Feb 2015; n=1330, 56% female, age 57.2+/-11.436 years, HbA1c 7.39+/-1.46%), 33% had a CES-D>/=16 and only 58.9% completed the program. A CES-D cutoff of 14 and 20 predicted non-completion with optimal accuracy in men and women, respectively. In men, depressive symptoms predicted fewer sessions attended, as did the use of an antidepressant and poorer baseline fitness. In women, baseline antidepressant use, higher HbA1c, and poorer fitness predicted fewer sessions attended.
Conclusion: Depressive symptoms were highly prevalent among rehabilitation participants with T2DM, and they were associated with non-completion and fewer sessions attended.

13. Location, Modality and Degree of Exercise Over 18 Months in Cardiac Rehabilitation Graduates

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1 Cardiovascular Prevention and Rehabilitation Program, University Health Network; 2 University of Ottawa Heart Institute; 3 School of Kinesiology and Health Science, York University

Patients who participate in cardiac rehabilitation (CR) significantly increase their physical activity. However, exercise adherence often decays post-program, leading to poorer prognosis. Some community exercise facilities are a safe option for cardiac patients; they display the “Heart Wise Exercise” (HWE) logo (http://heartwise.ottawaheart.ca/). The objective of this study was to describe where patients exercise post-CR, and if HWE facilities are used. This study presents secondary analysis of an ongoing randomized controlled trial (ECO-PCR) investigating a post-CR exercise facilitation intervention. Participants completed a questionnaire at CR discharge, 6, 12, and 18-months post-CR. At the 6-month assessment, 176 (78.2%) participants exercised at home, 106 (47.1%) in their community, 110 (48.9%) at another location. Of those that exercised in the community, 37 (17.1%) exercised at a CR-recommended facility, 17 (7.8%) at a HWE program, and 83 (38.4%) at another location. Overall, 219 (97.8%) engaged in individual activities, primarily walking (n=200, 89.7%). At the 18-month assessment, 56 (76.7%) participants exercised at home, 32 (44.4%) in their community, 37 (51.4%) at another program type, and 3 (4.2%) did not exercise anywhere. Of community-based exercisers, 11 (16.2%) exercised at a CR-program-recommended facility. CR graduates most often exercised at home, followed by community settings. HWE programs were infrequently attended, which may be due to the newness of the program. Efforts to improve awareness are now underway.

14. Determining Cardiac Rehabilitation Patients' Adherence to Exercise & Sitting Recommendations

A Biswas1, PI Oh2, GE Faulkner3, DA Alter2,4

1 Institute of Health Policy, Management and Evaluation, University of Toronto; 2 Toronto Rehabilitation Institute; 3 Faculty of Kinesiology and Physical Education, University of Toronto; 4 Institute for Clinical and Evaluative Sciences.

Background: It is unclear whether prolonged sitting is prevalent among exercise-engaged populations, and the extent of their risk.

Objectives: This study determined the extent to which cardiac rehabilitation patients participate in exercise and sedentary behaviours. Correlations between exercise time and sitting times were also analysed to evaluate any associations between the two behaviours.

Methods: The sitting and exercise times for 31 participants were measured over 12-weeks of a cardiac rehabilitation program. Participants wore accelerometers and self-reported their time spent exercising and sitting. Participants who met exercise and sedentary time recommendations and the linear association between the two were also examined.

Results: No correlation was found between sitting and exercise times (r= -0.08, P=0.812). All were highly sedentary and the majority met their weekly exercise recommendations. Sitting times (F-value=1.19, P=0.3) and exercise times (F- value=1.623, P=0.093) did not change significantly over the 12-weeks.

Conclusion: While all participants were found to be highly sedentary over the duration of the 12-week study, the majority were regularly engaged in exercise. These findings suggest that cardiac rehabilitation patients are likely to be at lower risk for the hazardous consequences of prolonged sedentary behaviour provided that the programs are effective in promoting regular exercise adherence.

ABSTRACTS –SLEEP SCIENCE TEAM (15 – 19)

Team Leader: Dr. Doug Bradley

The Sleep Science Team focuses on the diagnosis and treatment of sleep apnea. Sleep apnea is a very common condition, yet has been diagnosed in only a fraction of cases. This team has shown that, undiagnosed and untreated, sleep apnea is a frequent cause of stroke and cardiac events. They have developed and commercialized a portable device that will allow diagnosis of obstructive sleep apnea to be achieved in the comfort of the patient's home. This has the potential to fundamentally alter the means by which sleep apnea is diagnosed and treated. Their important work continues: determining causes of sleep apnea; and understanding the effects on health and rehabilitation outcomes of treating sleep apnea in patients with cardiovascular and cerebrovascular diseases.

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15. Application of Electrical Stimulation of the Calf Muscle to Reduce Seated Leg Fluid Accumulation and Rostral Fluid Shift While Supine

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Leg fluid accumulated during the day can shift rostrally from the legs to the neck when lying down to sleep, narrow the upper airway and worsen sleep apnea. The objective of this study is to test the efficacy of electrical stimulation (ES) of the calf muscle on reducing daytime leg fluid accumulation and rostral fluid shift upon lying supine. The study is a randomized double cross over, which involved participants sitting for 2.5 hours receiving active or sham ES (control); then lying supine for 1 hour. Leg and neck fluid volumes were measured using bioimpedance. After one-week, participants crossed over to the other study arm. Fourteen men (age: 48.3±6.2 years, BMI: 27.2±6.4) completed the protocol. ES reduced leg fluid accumulation compared to control ($p<0.001$). Compared to control, less fluid shifted out of the leg ($p < 0.001$) and entered the neck while supine ($p < 0.001$). These results suggest that ES is an effective means of reducing seated leg fluid accumulation while seated and rostral shift into the neck when supine. Future work should investigate the effects of long-term ES on fluid dynamics and sleep apnea severity.

16. Bioimpedance as a Predictor of Sleep Apnea Due to Fluid Overload

B Gavrilovic1,2, D Vena1,2, O Lyons1,2, TD Bradley1,2, MR Popovic1,2, A Yadollahi1,2

1 Toronto Rehabilitation Institute - UHN; 2 University of Toronto

Prevalence of obstructive sleep apnea (OSA) is higher in fluid retaining patients and worsens with overnight fluid accumulation in the neck. The objective of this study was to investigate new biomarkers for predicting patients who are at a high risk of OSA due to fluid overloading.

15 men participated in a randomized double crossover study. While asleep, about 2L or negligible amounts of saline (intervention and control arms) were infused intravenously and sleep was assessed by polysomnography. Subjects crossed over to the other arm a week later. Before and after sleep, neck circumference and bioimpedance of the neck at 50 kHz were measured to estimate resistance, reactance, and phase angle. The participants were separated into high and low risk groups based on changes in OSA severity from control to intervention.

Our results showed during both study arms, all bioimpedance measures changed from before to after sleep. Furthermore, neck circumference and phase measured before sleep were significantly larger in

the high risk than the low risk group; which may represent higher pharyngeal tissue mass in high risk group. These results could be used to predict patients in postoperative situations, who may have an increased risk of developing OSA with fluid overload.

17. Development of an Acoustic Model for Investigating the Effects of Upper Airway Anatomy on Snoring Sound Features

S Saha1,2, M Taheri2, TD Bradley2, Z Mossuavi1, A Yadollahi2

1 Department of Biomedical Engineering, University of Manitoba; 2 Toronto Rehabilitation Institute-University Health Network

Snoring is generated by vibrations of pharyngeal tissues due to the narrowing of the upper airway (UA) and the consequent increases in the turbulence of airflow in the UA. Although variations in the UA anatomy during sleep have a huge impact on snoring, the role of UA anatomy on snoring features is still not fully investigated. This study aims to develop an acoustic model for snore generation and propagation to investigate the impacts of changes in the UA anatomy on snoring. We developed an acoustic model of the pharynx considering it as a collapsible tube. The model included acoustic losses due to airflow through the pharynx and effects of pharyngeal wall vibrations. Then, we investigated the effects of variation in each variable of the model on snore features and compared it with results obtained from recorded snores of 20 men. Our modelling results showed that narrowing in the UA during sleep was strongly correlated with increases in the model gain ($r=-0.93, P<0.001$); this complied with recorded snores that UA narrowing during sleep increased the snoring intensity ($r=-0.53, P=0.018$). These results could be used to develop a snore driven non-invasive method to assess the severity of UA narrowing during sleep.

18. Effect of Rostral Fluid Shift on the Pathophysiology of Asthma

SA Bhatawadekar1, L Jung2, O Lyons1, S Tarlo2, A Yadollahi1,2

1 Toronto Rehab Institute - UHN; 2 University of Toronto

In supine, fluid accumulated in the legs due to gravity shifts to the neck, and narrows the upper airway. However, it is unknown whether the same fluid shift to the chest may contribute to pulmonary airway narrowing and nocturnal asthma. To investigate the effects of fluid shift on the pathophysiology of asthma, we designed a randomized double crossover study. While supine, subjects were randomized to the application of lower body positive pressure (LBPP), or none (Control); and then crossed over. In 10 asthma and 11 healthy subjects, respiratory resistance (Rrs) and reactance (Xrs) were measured by impulse oscillometry. Fluid volumes in the leg, thorax, and neck were estimated using the bioelectrical impedance technique. In healthy subjects, Rrs and Xrs did not change during either study arms. Interestingly in asthmatics, with LBPP, Rrs increased and Xrs decreased significantly. Decreases in Xrs may suggest small airway narrowing with the accumulation of fluid in the thorax. Moreover, women showed larger changes in Rrs and Xrs than men. Together our results suggest that fluid shift may contribute to overnight worsening of nocturnal asthma, especially in women. Further studies are required to confirm and examine the effect of fluid shift on severity of asthma.

19. Design and Validation of a Wearable Non-invasive Device (The Patch) to Monitor Cardio-Respiratory Signals during Exercise

M Shokrollahi1,2,3, PM Hadi1,3, F Rudzicz1,2, B Westhead3, A Yadollahi1,4

1 Toronto Rehabilitation Institute, University Health Network; 2 Department of Computer Science, University of Toronto; 3 BresoTec Inc.; 4 Institute of Biomaterials and Biomedical Engineering, University of Toronto

This abstract has been withheld to avoid public disclosure of confidential information.

ABSTRACTS –MOBILITY TEAM (20 – 27)

Team Leader: Dr. Avril Mansfield

The Mobility Team researches how to improve safe independent functional mobility for all individuals with motor impairment, and prevent loss of mobility within healthy individuals. Our research activities are focused on four areas: 1) advancing our understanding of the barriers and facilitators to safe independent mobility; 2) developing and evaluating new clinical assessment tools; 3) developing and evaluating interventions to facilitate optimal recovery of function and remediate barriers to safe independent mobility; and 4) implementing clinically meaningful assessments and successful interventions into clinical practice. We are a transdisciplinary team; our members have expertise in the study and/or treatment of human movement (e.g. kinesiologists and physiotherapists), structure and design (e.g. engineers), and medicine (e.g. physicians and nurses). Our research has applications in geriatric, neuro-, and pulmonary rehabilitation.

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20. After Traumatic Brain Injury: A Longitudinal Recovery Study

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1 Rehabilitation Sciences Institute, University of Toronto; 2 Toronto Rehabilitation Institute 3 Sunnybrook Research Institute

Introduction: After traumatic brain injury (TBI), balance control is impaired, with unilateral motor weakness and asymmetrical standing posture. Global measures of balance (net centre-of-pressure (COP) displacements) lack information about the individual contribution of each foot. Inter-limb synchrony is a sensitive measure of individual limb contributions to postural stability in healthy adults and clinical populations.

Methods: Standing balance was collected from 35 TBI patients (at 1.5, 5, 12 months after injury) and 22 healthy controls (HC). Participants stood on two adjacent force plates (45 seconds) in three conditions. AP and ML COP root mean square (RMS) measures of standing balance and cross-correlation coefficient at zero phase lag (Rxy(0)) were calculated.

Results: In TBI patients, a 3x3 ANOVA revealed a Condition effect in AP RMS and Rxy(0); however ML RMS significantly decreased over time ($p<0.05$). Net COP RMS was significantly higher across recovery in TBI patients than HC in both the AP and ML direction ($p<0.05$). **Conclusions:** Inter-limb COP synchrony of TBI patients is not different than that of HC. However, the overall displacement of the COP did differ between groups. These results indicate that despite some recovery of balance control in TBI patients, it continues to be disrupted a year after injury.

21. Differences in Quiet Standing Centre of Pressure Measures Based on Balance Recovery Ability in Individuals with Stroke

A Schinkel-Ivy1, JC Singer2, EL Inness1,3, A Mansfield1,3,4

1 Toronto Rehabilitation Institute – University Health Network; 2 University of Manitoba; 3 University of Toronto; 4 Sunnybrook Research Institute

Introduction: Control of quiet standing is impaired in individuals with stroke, although examination of reactive control specifically is lacking. This study determined whether quiet standing measures at frequency levels representative of reactive control differed based on balance recovery ability in individuals with stroke.

Methods: At admission to in-patient rehabilitation, individuals with stroke completed 30 seconds of quiet standing and lean-and-release postural perturbations. Quiet standing centre of pressure (COP) signals were calculated and discrete wavelet decomposition was performed. Between-limb synchronization, net COP amplitude, and ratios of individual-limb COP were determined for each frequency level, and for the non-decomposed signal. Outcome measures were compared between individuals who exhibited failed and successful responses during a) unconstrained and b) encouraged-use lean-and-release trials. **Results:** Individuals with failed responses during the unconstrained lean-and-release trials displayed greater net COP amplitude than those with successful responses, specifically within a frequency range of 0.40–3.20 Hz.

Discussion: Reduced balance recovery abilities among individuals with stroke may be reflected in impaired reactive control of quiet standing. These findings provide insight into the mechanism by which reactive control of quiet standing is impaired in individuals with stroke, and may inform assessment and rehabilitation strategies for post-stroke reactive balance control.

22. The Impact of Falls on Recovery After Discharge From In-Patient Stroke Rehabilitation

JS Wong1,2, D Brooks1,2, EL Inness1,2, A Mansfield1,2,3

1 Toronto Rehabilitation Institute - UHN; 2 University of Toronto; 3 Sunnybrook Research Institute

Background: Falls are common among community-dwelling stroke survivors. The aim of this study was to (1) compare motor and cognitive outcomes between individuals who fell in the six months post-discharge from in-patient stroke rehabilitation and those who did not fall, and (2) explore potential mechanisms underlying the relationship between falls and recovery of function.

Methods: Secondary analysis of a prospective cohort study was conducted. Participants completed a six-month falls monitoring period using postcards with follow-up. Non-fallers and fallers were compared at follow-up on the Berg Balance Scale (BBS), Chedoke-McMaster Stroke Assessment (CMSA), gait speed, and Montreal Cognitive Assessment (MoCA). Balance confidence and physical activity were also assessed.

Results: 23 fallers were matched to 23 non-fallers on age and discharge functional balance scores. At follow-up, BBS scores ($p=0.0066$) and CMSA foot scores ($p=0.0033$) were significantly lower for fallers than non-fallers. The two groups did not differ on CMSA leg scores, gait speed or MoCA ($p>0.05$). There was no significant association between change in balance confidence scores and change in physical activity levels from the first and third questionnaire ($r=0.27$, $p=0.08$).

Conclusions: Performance in balance and motor recovery of the foot were compromised in fallers when compared to non-fallers at six months post-discharge from stroke rehabilitation.

23. Investigating Balance, Plantar Pressure, and Foot Sensitivity of Individuals with Diabetes during Stair Gait: Pilot Research

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Introduction: Diabetic peripheral neuropathy (DPN) is a result of diabetes mellitus. DPN is a dysfunction of the peripheral nerves that restricts sensation from the limbs, constraining one's mobility and quality of life. Furthermore, the plantar cutaneous sensation of DPN individuals is reduced, compromising their balance. To compensate, they generate greater foot pressures while walking - often leading to tissue ulcerations, or possibly lower-extremity amputations if left untreated. As well, foot pressures during stair gait are greater than level walking. Currently, there are diabetic insole devices that offload foot pressures and limit ulcer formation; however these devices fail to address concurrent issues of balance and fall risks.
Pilot Aims: Investigate stair gait kinematics, balance, and plantar pressure in healthy young individuals.
Methods: Healthy young individuals (n=5) will traverse a moving staircase, while instrumented with pressure sensor insoles and reflective markers to record joint angles, balance and plantar pressure.
Preliminary Results: Healthy individuals when perturbed demonstrate increased, prolonged and unpredictable joint angles, during stair descent.
Future research plans: Quantify stair gait kinematics, balance, and plantar pressures of individuals with DPN during stair gait.

24. Changing Pattern of Sedative Use in Older Adults

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1 Mobility Team, Toronto Rehabilitation Institute; 2 Department of Psychiatry, University of Toronto; 3 Centre for Mental Health, University Health Network; 4 Institute of Clinical Evaluative Sciences; 5 Department of Psychiatry, Sunnybrook Health Sciences Centre

Background: Benzodiazepine use in older adults has been decreasing. However, there has been no overall decline in psychotropic use. Trazodone and quetiapine are two sedating medications used off-label for sleep or behavioural symptoms. Our objective is to describe the shifting patterns of sedative prescription in older adults by comparing changes in benzodiazepine, trazodone and quetiapine dispensing over an 11-year period.
Methods: We used linked health-care databases in Ontario to identify residents over 66 years in each quarter from January 2002- March 2013, dividing the cohort by residence in the community and in long-term care. We compare the rate of dispensing of these drugs in each quarter and characterize their changing use over time by age, sex, and diagnosis of dementia.
Results: We demonstrate that use of low-dose trazodone and quetiapine is increasing, coinciding with a decrease of benzodiazepine prescription. This pattern is particularly apparent in the oldest cohort and those with dementia. There are high rates of sedative and psychotropic polypharmacy.
Interpretation: Benzodiazepine use is decreasing in Ontario, but there is a shift towards low-dose, off-label use of trazodone and quetiapine and psychotropic polypharmacy. It is important to establish if these sedatives are efficacious and safe in this vulnerable population.

25. Literature Review on the Practice of Occupational Therapy Home Assessments

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Background: Home assessment (HA) is administered by occupational therapists to facilitate safe transition to home after discharge. However, there is a lack of consensus among practitioners regarding a standard set of assessments that would best fit the client's needs.
Methods: The aims of this study are to review current practices and types of occupational therapy (OT) HA; and to determine if OT HA is evidence-based and standardized. The following keywords were used in the literature search: Canadian Occupational Performance Model, OT Home Assessment, Person Environment (PE) Fit or Activity or Occupation; and Usability Checklist. 30 articles in English were included as of last database access on July 11, 2012.
Results: Review revealed inconsistent evidence on effectiveness of OT HA and that OT HA is based on non-standardized decision making practices and protocols. The literature also confirmed the large array of commonly used tools to administer HA.
Discussion: Lack of agreement among practitioners reflects potential issues on clarity of constructs to describe PE transactions. There is a need to clarify HA theoretical framework and to develop evidence-based HA tools.
Conclusion: Addressing the lack of consensus is needed towards developing standardized and more effective OT HA protocols and meaningful interventions.

26. Previous Experiences and Central Set Development to Complex Moving Environments: Would Dancers Make Good Seafarers?

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1 Toronto Rehabilitation Institute, University Health Network; 2 Faculty of Kinesiology, University of Waterloo; 3 Department of Psychology and Neuroscience, Dalhousie University, Halifax; 4 School of Human Kinetics and Recreation, Memorial University, St. John's

This study aimed to determine if those who had long-term exposure to balance instability, such as those who train on specific skills that demand balance control, will have improved ability to adapt to complex continuous multidirectional perturbations. Three groups (10 participants per group) with varied long term exposure to balance demanding conditions were tested under simulated maritime motion. Individuals attempted to stand still while being exposed to five, 5-minute trials of induced motion on a 6-degree of freedom motion platform. Trials were videotaped. Frequency of change in support reactions (CS), time spent performing CSs, number of steps, and # of multistep reactions were recorded for each 5-minute trial. Experienced workers had lowest time performing CSs and number of multi-step CSs when compared to dancers and inexperienced individuals. Dancers spent less time performing CSs and had fewer multi-step CSs than inexperienced individuals. These results suggest that central set development of postural response to novel complex environment may be improved by long-term experience with environments or skills that require sophisticated balance control. Importantly, that the benefits were greatest among those with experience with similar environments (i.e. maritime environments versus dancers) reinforces the benefits of task specific long-term training.

27. A Bilateral Lower-Extremity Mirror Therapy Intervention Post-Stroke: Proof-of-Concept to Pilot

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1 Western University, Health and Rehabilitation Sciences; 2 Rehabilitation Science Institute, University of Toronto; 3 Toronto Rehabilitation Institute; 4 University of Toronto, Department of Physical Therapy

Mirror therapy (MT) superimposes movements of an intact limb over an affected limb to provide appropriate visual feedback about the attempted affected limb movement. This study aimed to investigate the potential use of a bilateral lower-extremity MT intervention (LE-MT) as an adjunct therapy to improve LE motor impairment and gait after stroke.

A case series (n=3) with individuals with stroke. Twelve 30 minute LE-MT sessions were delivered as an adjunct to conventional physiotherapy. Number of repetitions, rests and session duration were recorded. Motor impairment and spatiotemporal gait parameters were assessed pre and post-intervention.

LE movement repetitions increased over 12 sessions and number of rests decreased in two participants. Session during increased or was maintained over 12 sessions. Gait velocity and step length variability improved in two participants. Limb ataxia improved in two cases. One participant reported a recurrent episode of pre-existing back pain outside of the LE-MT sessions.

A LE-MT adjunct intervention for stroke was tolerated by participants. However, a history of low back pain may be a precaution. A pilot RCT will be conducted to investigate bilateral LE-MT as an adjunct therapy for improving motor impairment, gait, and EMG gait profiles in subacute stroke.

ABSTRACTS –NEURAL ENGINEERING & THERAPEUTICS TEAM (28 – 39)

Team Leader: Dr. Milos Popovic

The Neural Engineering and Therapeutics (NET) Team is primarily focused on translational research to advance understanding of neurological recovery, neurorehabilitation, and quality of life for individuals with spinal cord injury (SCI). Since its inception, the team has been developing neuroprosthetic systems and assistive technologies, neurorehabilitation tools and interventions, and clinical assessment tools for individuals with SCI and other neurologic impairments. Most of the NET Team's current interventions have potential for immediate clinical application within five years. Besides developing therapies, assessments, and new practices, the NET Team has evaluated the impact of these interventions on patients and their families.

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28. Surgical Management and Rehabilitation of the Elderly with Traumatic Cervical Spinal Cord Injury: A Cost-Utility Analysis

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Background: The aging of the population has modified the epidemiology of traumatic spinal cord injury (SCI). Given the escalating healthcare costs, a cost-utility analysis (CUA) was undertaken to assess the economic impact of older age (≥65 years of age) in the context of acute surgical management and rehabilitation of traumatic cervical SCI.

Methods: The CUA was performed under the perspective of a public health care insurer with a time horizon of 6 months post-SCI. Costs were estimated in 2014 US dollars. Utilities were generated from the STASCIS.

Results: The baseline analysis indicated that surgical and rehabilitative management of SCI in the elderly is more costly, but similarly effective, than in younger adults. When considering acute spinal surgical management and rehabilitation of younger adults with SCI as the baseline, the incremental cost-effectiveness ratio analysis revealed an additional cost of US$ 5,655,557 per QALY gained when managing elderly patients with SCI. The probabilistic analysis confirmed that spinal surgery in the elderly is more costly but similarly effective to younger adults post-SCI, although there is no definitive dominance.

Conclusions: This economic analysis indicates that surgical management and rehabilitation of acute traumatic cervical SCI in the elderly is more costly but similarly effective when compared with younger adults with similar injuries.

29. Training Walking after Pediatric Spinal Cord Injury: A Systematic Review of Participants, Parameters and Efficacy

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Walking is a primary focus of rehabilitation after spinal cord injury (SCI). For adults with SCI, there is a significant amount of research to guide walking training in clinical practice. For children, however, there has been no synthesis of the research on walking training. Thus, we completed a systematic review on walking interventions for pediatric SCI. Our objective was to identify the participant characteristics and training parameters that lead to improved walking in this population. Four databases were searched. Of the 103 abstracts screened, 32 articles were retained for full-text review and 10 articles were included. Of the 42 participants included across studies, most were aged >10 years. Participants had both motor complete and incomplete injuries. Interestingly, children with motor complete injuries showed similar walking gains as children with incomplete SCI; contrary to previous findings in adults with SCI. Two clear patterns emerged with respect to training prescription. First, all training programs, even those focused on treadmill walking, included some practice of over-ground walking. Second, gains in walking were greater with greater training doses (i.e., greater frequency and session duration). Although the number of included studies was small, the collective results provide direction for future research and clinical practice.

30. How Do Individuals with SCI Balance in Water?

AR Marinho-Buzelli1,2, K Masani2,3, H Rouhani4, MC Verrier1,2,5, MR Popovic1,2,3

1 Rehabilitation Science Institute – University of Toronto; 2 Toronto Rehabilitation Institute – University Health Network; 3 Institute of Biomaterials and Biomedical Engineering – University of Toronto; 4 Department of Mechanical Engineering – University of Alberta; 5 Department of Physical Therapy – University of Toronto

Introduction: Aquatic therapy is a common therapeutic approach for recovery of balance after a spinal cord injury (SCI). However, there is lack of evidence of the effect of immersion in water on postural sway. We investigated how the aquatic environment influences quasi-static posture in individuals with SCI, measured by center of pressure (CoP) parameters and trunk acceleration.
Methods: Six individuals with SCI (age 42-69 y, weight 49.4-88.3 kg, and height 162-180 cm) participated. Root mean square (RMS_{COP}), mean velocity (MVELO) and area of sway (AREA) were analyzed during 55-sec of quiet standing task. Ratio of upper to lower trunk RMS acceleration (ACC_{RATIO}) was also evaluated. Eyes open (EO) and eyes closed (EC) conditions were randomized in 10 trials with five trials each.
Results: Body weight offload in water varied from 39% to 63%. RMS_{COP}, MVELO and AREA were larger in water compared to land, and with EC compared to EO. ACC_{RATIO} in anterior-posterior direction was increased in water compared to land.
Conclusion: The aquatic environment increased COP fluctuation of individuals with SCI. Upper trunk acceleration was larger in water in response of increased instability. The instability caused by water may be a stimulus for balance recovery after SCI.

31. Restoring Arm Function Using Advanced Neuroprosthetic Technologies

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We recently used an EEG-triggered neuroprosthesis for grasping to deliver Functional Electrical Stimulation Therapy (FET) to restore upper limb function. The single participant sustained a stroke six years prior to the study resulting in severe left hemiplegia. He had participated in different therapies, including regular FET, none of which improved his arm function. Similar to standard FET, the participant attempted functional reaching movements which were facilitated using electrical stimulation delivered to several muscles on his left arm. However, rather than using a switch pressed by a therapist to deliver the stimulation, the neuroprosthesis was activated by detecting the participant's intention to move his affected limb through real-time analysis of his EEG activity recorded with a single electrode. After 60 hours of EEG-triggered FET, we registered a significant improvement in his upper limb function (Fugl-Meyer +6). Additional participants will be recruited. These early positive results are very encouraging and suggest feasibility and a real potential that this new technology has for restoring voluntary movement in individuals with severe hemiplegia resulting from stroke, a population that does not benefit from other forms of therapy.

32. The Feasibility and Validity of Body-Worn Sensors to Measure Gait in Pediatric Populations

L Sivarajah1,2, KJ Kane3, JL Lanovaz4, DL Bisaro3, AR Oates4, KE Musselman1,3,5

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Walking is an important goal for children with neurological conditions, such as cerebral palsy (CP) and spina bifida (SB). As a result, walking is often targeted in rehabilitation programs. Clinical measures of walking are limited to simple assessments of speed and distance. More sophisticated methods, such as 3D motion capture systems and instrumented walkways, are typically not accessible to clinicians. Moreover, these measurements can be challenging to perform in young children. A feasible and valid method of measuring gait parameters in children with neurological conditions is needed. To address this need, we evaluated the feasibility and validity of body-worn sensors (Mobility Lab, APDM Inc.) as a means to measure various spatiotemporal gait parameters in 15 high functioning children with CP or SB aged 2-13 years. The children walked 10m (walking aids permitted) in a clinical setting while wearing the Mobility Lab system, which calculated several spatial and temporal measures. We found that measures of trunk range of motion (horizontal plane) and swing asymmetry could distinguish the children with CP or SB from a group of typically-developing children, demonstrating discriminative validity. Thus, the use of body-worn sensors is a feasible and valid approach to gait assessment in clinical environments.

33. Using Spatiotemporal Templates for Pathway Discrimination in Peripheral Nerve Recordings: A Simulation Study

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1 University of Toronto, Institute of Biomaterials and Biomedical Engineering; 2 Toronto Rehabilitation Institute; 3 University of Toronto, Edward S. Rogers Sr. Department of Electrical and Computer Engineering; 4 University of Toronto, Department of Mathematics

Neuroprosthetics are artificial systems that interface with the nervous system in order to restore function. Implanted functional electrical stimulation (FES) has been used to restore some movement after paralysis due to spinal cord injury, but current implementations of this technique use only predefined stimulation patterns and thus can only produce coarse movements. Creating closed-loop FES systems would improve movement quality but would require appropriate feedback signals, which are

currently lacking. Nerve cuff electrodes could be used to extract feedback signals from the sensory information in peripheral nerves, if their recording selectivity could be improved. Novel signal processing approaches are needed to address this issue. Signals obtained from peripheral nerve recordings are typically analyzed with respect to their temporal variations, and recently with respect to their spatial variations (source localization). We hypothesize that by coupling spatial and temporal information together to characterize each neural pathway by its complete spatiotemporal "fingerprint", we will develop algorithms for selective nerve cuff recordings that outperform existing techniques. Preliminary testing has been done using three pathways with non-overlapping activity at different noise levels, and results suggest that the incorporation of both the spatial and temporal information allows for improved discrimination of an active pathway.

34. Multi-Electrode Sequential FES Improves Fatigue Resistance

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Muscle fatigue is a major limiting factor in the use of functional electrical stimulation (FES) for rehabilitation and motor relearning of individuals with paralysis. FES induces rapid muscle fatigue because muscle fibres have to be activated at unnaturally high frequencies to generate functional contractions. FES using sequential stimulation with multiple electrodes has been proposed to reduce stimulation frequencies and subsequent muscle fatigue. To apply this method clinically, our lab developed a generic adapter that may be used with any commercial electrical stimulator. The purpose of this project was (1) to test the adapter's performance and (2) to use the adapter to investigate whether two independently proposed sequential FES techniques, namely Spatially Distributed Sequential Stimulation (SDSS) and Sequential Multiple Muscle-Head Stimulation (SMHS), are capable of reducing fatigue compared to conventional Single Electrode Stimulation (SES) for isokinetic knee extension. Performance of the adapter was found to be similar to output of the stimulator within acceptable error. In the subsequent experiment with eleven able-bodied individuals, both SDSS and SMHS significantly reduced fatigue compared to SES (measures: fatigue index, torque peak mean, low frequency fatigue). SDSS and SMHS delivered via adapter pose an attractive alternative to SES during clinical applications.

35. The Rick Hansen Spinal Cord Injury Registry: Consent and Retention Rates 2010-2015

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Background: The Rick Hansen Spinal Cord Injury Registry (RHSCIR) is a national registry of individuals with a traumatic spinal cord injury (tSCI) intended to obtain routine clinical and demographic information.
Objective: To describe outcomes of the process of consent to enrolment at TRI-Lyndhurst from June 2010 to October 2015, inclusive.
Methods: Local tracking spreadsheets were used to collect data on the screening, recruitment, data collection, and participant retention rates.
Results: During the course of the study, there were 1515 patients screened at rehab admission for eligibility and approximately 32% (n=484) sustained a tSCI. Of the patients eligible for enrolment, 67% consented and 33% declined. Using the central recruitment (CR) process, patients can express their interest in research participation prior to being approached, which demonstrated a high RHSCIR consent rate (81.5%). Following discharge from rehabilitation, we had a high loss to follow-up rate, for one, and two-year community questionnaires, with completion rates of 41% and 23%, respectively.
Conclusions: Local implementation of the CR process demonstrated a high consent rate by providing the patient with more authority in their involvement in research. We plan to explore methods to increase

participant retention rates and to enhance the quality of community follow-up processes and completion rates.

36. Quality Improvement Strategies to Eliminate Urinary Tract Infections During Inpatient SCI Rehabilitation

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Background: Urinary Tract Infections (UTI) are a frequent cause of service interruptions during inpatient Spinal Cord Injury (SCI) rehabilitation.
Objective: To reduce the frequency and severity of UTIs, and their impact on length of stay among adults with subacute SCI.
Methods: Data were prospectively collected from 3 inpatient units for 6-weeks. Prescribing physicians completed a signs and symptoms checklist after each written urine C&S order. Descriptive statistics were used to summarize the practice audit results.
Results: 36 of 57 inpatients had urine sent for C&S. Most, 26/36 (56%) had at least two signs prompting C&S order. A majority of inpatients (58%, 21/36) were subsequently diagnosed with a UTI. Fifty percent of UTI's were due to E-coli, an additional 25% were due to E Coli plus Grp-B-strep, Klebsiella, Proteus mirabilis, or Enterococcus; all were treated with oral antibiotics. A majority of UTI's (85%) occurred in patients with self or nurse-administered intermittent catheterization (IC). **Discussion:** These practice audit results will inform the next steps of our QI strategy including: i) establishing best practices; ii) creation of Fishbone diagrams to map quality care opportunities; iii) staff participation in rapid improvement events; and, iv) monitoring of advances in care on UTI outcomes.

37. Characterization of Ischial Tissue Health in Individuals with Spinal Cord Injury (SCI)

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Background and Rationale: Deep tissue injury (DTI), one form of pressure ulcer (PU) occurs in muscle over bony prominences (Stekelenburg et al., 2008). Although DTIs are difficult to detect prior to appearing at the skin layer, hypoechoic areas in tissue overlying the ischial tuberosity (IT) correlate with DTI (Aoi et al., 2009). Few studies have quantified ischial tissue health (ITH) using ultrasound imaging.
Objectives: To establish a protocol for quantifying ITH in individuals with SCI using ultrasound imaging.
Methods: Ultrasound images were collected over the IT in side lying in 8 individuals (21-53 years) with SCI (C5-L1, traumatic and non-traumatic, AIS A-D). Parameters for the region of interest and measures for thickness and echogenicity of the skin, subcutaneous tissue and muscle were established using a customized MATLAB program.
Results: The thickest area of the tissue overlying the IT was the area occupied by muscle, followed by subcutaneous tissue and skin. Echogenicity was highest in the skin, and lowest in subcutaneous tissue.
Implications: A protocol for determining ITH was developed to investigate differences in a population with SCI to determine the feasibility of detecting impending DTI, which may assist PU prevention.

38. A Wearable Interaction Detection System for Monitoring Hand Use at Home

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The restoration of upper limb function is usually rated as the top priority for individuals with cervical spinal cord injuries. In order to develop effective novel rehabilitation therapies and modify current treatments to suit an individual's needs, it is important to assess hand function throughout the rehabilitation process. Current upper limb evaluations are based on standardized assessments performed by a clinician in a controlled setting; however, there is currently no method capable of providing information about hand use in the community. In this study, a wearable system is presented that can monitor interactions of the hand with objects at home using computer vision techniques applied to a first-person camera sensor. We propose that quantifying how often the hand performs functional interactions can serve as a meaningful outcome measure for upper extremity function in the community. Our results suggest that using first-person video to monitor hand use at home is feasible.

39. Correlations Between Functional Independence Measure® and Pressure Ulcer Risk During Inpatient Spinal Cord Injury Rehabilitation

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Pressure ulcers (PUs) are common and costly complications following spinal cord injury (SCI). PU risk assessments are intended to identify individuals at highest risk for developing PUs. This study examines the relationships between the motor Functional Independence Measure® scale (mFIM), Braden Scale, SCI Pressure Ulcer Scale (SCIPUS), and PU incidence during inpatient SCI rehabilitation. Charts were abstracted from 617 inpatients following discharge from SCI rehabilitation including patient demographics, PU incidence, mFIM, Braden, and SCIPUS scores. Data were analyzed for relationships between outcomes (Spearman correlation), differences in scores between those with and without PU incidence (ANOVA), and sensitivity and specificity for each outcome using PU incidence. Patients who developed PUs had lower mFIM scores at admission (28 vs. 42) compared to those who did not ($p<0.0001$). mFIM had a stronger correlation to Braden ($r=0.77$) than SCIPUS ($r=-0.45$). Sensitivity/specificity analysis showed that the Braden and SCIPUS had low likelihood ratios (LR) for predicting PU incidence (1.5, 1.1 respectively) when using existing high risk cut-off values. Using a cut-off value of ≤32 to indicate high risk, mFIM had a LR of 2.1, suggesting that mFIM may be as good or better as existing risk assessment tools for predicting PUs in inpatient SCI rehabilitation.

ABSTRACTS –SWALLOWING SCIENCE TEAM (40 – 42)

Team Leader: Dr. Catriona Steele

The Swallowing Science Team consists of a multidisciplinary group of individuals including speech-language pathologists, PhD students and clinical engineers who are driven to discover ways to improve clinical practice and treatment outcomes for individuals with swallowing impairment. They find solutions by exploring the mechanisms underlying swallowing impairment. There are several main foci of research for this team: tongue function; viscosity and texture modification; best practice; swallowing accelerometry; treatment studies; and nutrition and oral hygiene.

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40. Reduced Tongue Strength Does Not Affect Sensory Tests of Tactile or Viscosity Discrimination

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1 Toronto Rehabilitation Institute; 2 University of Toronto, Rehabilitation Sciences Institute

Introduction: It is plausible to assume that sensory information obtained during bolus compression by the tongue enables tailoring of propulsion forces to bolus viscosity. We explored whether reduced tongue strength leads to higher sensory discrimination thresholds in healthy adults and adults with dysphagia.

Materials & Methods: Two experiments were conducted. Experiment 1 involved 340 healthy individuals aged 12-86. Experiment 2 involved adults with neurogenic dysphagia. Maximum isometric tongue pressures were measured and participants also completed a Tactile Discrimination Acuity Test and a triangle test viscosity discrimination task. Paired t-tests were used to compare individuals with dysphagia to their decade and sex group from Experiment 1.

Results: Tongue strength declined in healthy individuals >70, and in participants with dysphagia. Tactile discrimination was worse for healthy individuals aged ≥70 but did not differ in those with dysphagia. Viscosity discrimination did not differ as a function of age or dysphagia.

Conclusions: Adults ≥70 and patients with dysphagia have decreased tongue strength. Tactile discrimination also declines with age. Despite these changes, individuals with dysphagia do not have greater difficulty discriminating viscosity with thickened liquids. This suggests that individuals with reduced tongue strength should be able to detect and respond to differences in bolus viscosity.

41. Limited Functional Reserve Is Not a Characteristic of Neurogenic Dysphagia

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Introduction: Maximum isometric tongue pressures (MIPs) decline with healthy aging. Functional reserve (FR) is the difference between MIPs and swallowing pressures, and is also thought to decline with age. We explored whether MIPs and FR are reduced in individuals with dysphagia, compared to healthy controls.

Methods: In a retrospective sample with 43 adults with dysphagia peak anterior MIPs and regular effort saliva swallow (RESS) pressures were collected and FR was calculated. Individuals with dysphagia were compared to decade-based means from a sample of 340 healthy controls aged 12-86.

Results: The confidence intervals (CIs) for individuals with dysphagia were MIPs of 33-43 kPa and RESS pressures of 17-26 kPa. Both MIPs and RESS pressures were significantly lower than values seen for age-matched controls ($p < 0.001$). CIs for the healthy controls were MIPs of 43-47 kPa and RESS of 29-30 kPa. FR averaged 15 kPa in both groups.

Conclusions: In contrast to older healthy controls, who only show a reduction in MIPs, individuals with dysphagia also demonstrate a significant reduction in RESS. The impact of this reduction is to preserve an average gap of 15 kPa between MIPs and RESS. Thus, limited FR is not a characteristic of neurogenic dysphagia.

42. The Effectiveness of the Head-Turn-Plus-Chin-Down Maneuver for Eliminating Vallecular Residue

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Impaired swallowing efficiency can result in pharyngeal residue and may increase the risk of post-swallow aspiration. Clearance swallows in a head neutral position do not always clear residue. We investigated the impact of a novel maneuver on residue clearance by combining a head-turn with the chin-down posture. Data were collected from 26 participants who demonstrated persistent vallecular residue after an initial head neutral clearance swallow in videofluoroscopy. Participants were cued to perform ahead-turn-plus-chin-down clearing swallow. Pixel-based measures of residue in the vallecular space before and after the maneuver were made by blinded raters. Measures of %-full and the Normalized Residue Ratio Scale (NRRS) were extracted. Univariate ANOVAs were used to detect significant reductions in residue with the maneuver. More than 80% of pre-swallow measures displayed NRRS ratios >0.06; indicative of an increased risk for post-swallow aspiration. The maneuver reduced residue below this threshold 15% of the time ($p < 0.05$). Post-maneuver measures showed residue filling 21-36% of the valleculae for thin and nectar-thick liquids (NRRS: 0.04-0.11) and 45-62% for honey-thick and solid stimuli (NRRS: 0.17-0.41). These data suggest that the novel head-turn -plus-chin-down maneuver can be an effective strategy for reducing persistent vallecular residue, particularly with thin and nectar-thick stimuli.

ABSTRACTS –BRAIN DISCOVERY & RECOVERY TEAM (43 – 50)

Team Leader: Dr. Robin Green

The Brain Discovery & Recovery team focuses on the 1.1% of the Canadian population with enduring effects of traumatic brain injury, effects that can be debilitating and last decades. This team has been at the forefront of research that re-conceptualizes moderate-severe TBI as a chronic and progressive disease process rather than a one-time event. They are translating their basic research findings (new brain biomarkers and novel causes of brain decline) into evidence-based treatments designed to restore brain structure and function, and to ameliorate cognitive and emotional functioning. They are also working to scale up the delivery of treatment to patients through their participation in research, in order to fill a critical gap in both research and care in chronic TBI.

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43. Longitudinal Change in Hippocampal and Whole-Brain Functional Connectivity and the Cognitive and Behavioural Correlates following Moderate to Severe TBI

L Meusel1,2, R Green2

1 Rotman Research Institute, Baycrest; 2 Toronto Rehabilitation Institute – UHN

Background: Moderate to severe traumatic brain injury (TBI) is associated with cognitive impairment and changes in emotional functioning, which may increase over time into the chronic stages of injury. In the sub-acute phase of injury, these behavioural changes are paralleled by changes in functional connectivity in cognitive and emotional brain networks. Little is known about how network integrity evolves over the longer-term, and how these changes relate to behavioural recovery.
Methods: In order to explore the relation between changes in functional connectivity and behaviour across the subacute and chronic stages of injury, participants are undergoing a comprehensive neuropsychological assessment, structural brain imaging, and resting-state functional magnetic resonance imaging at 5, 12, and 24 months post-injury. Within each subject, hippocampal and whole-brain connectivity metrics will be examined in relation to the trajectory of cognitive and emotional functioning across time.
Results: Forty-two individuals completed the assessment at 5-months post-injury. Forty of those individuals also completed the 12-month assessment. At present, 9 individuals have completed a 24-month assessment. Preprocessing and analysis of these data is underway.
Discussion: These data will contribute to our understanding of the brain processes underlying recovery from TBI, across both the sub-acute and chronic stages.

44. A Case Study of Functional Connectivity Changes Following Melodic Intonation Therapy

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1 Toronto Rehabilitation Institute - UHN; 2 University of Haifa; 3 Department of Speech Language Pathology, University of Toronto; 4 Department of Psychiatry, University of Toronto

Melodic intonation therapy has been shown to be effective in the treatment of language disorders. However, little is known regarding the neural, and particularly functional connectivity changes that occur following melodic intonation therapy. In a case study, we investigated resting state functional connectivity before and after melodic intonation therapy in a traumatically brain injured (TBI) patient with severe expressive aphasia. The patient underwent an adapted form of internet based melodic intonation therapy. Changes in functional connectivity were compared to a TBI control patient that did

not undergo the intervention but who was scanned twice over the same time interval. The melodic intonation therapy-patient improved in her ability to respond to trained phrases, and an increase was found between language areas in the right hemisphere for the melodic intonation therapy-patient as compared to the control patient. These results provide support for further study to investigate the hypothesis that melodic intonation therapy enables preserved language areas in the right hemisphere to compensate for damage to areas in the left-hemisphere.

45. Clinical Utility of the Sport Concussion Assessment Tool-3 (SCAT3) in Varsity Athletes

RI Downey1, MG Hutchison3, D Richards3, P Comper1,2,3

1 University of Toronto, Graduate Department of Rehabilitation Science; 2 Toronto Rehabilitation Institute; 3 University of Toronto Faculty of Kinesiology and Physical Education

Sport-related concussion is a complex injury that remains challenging to evaluate and manage in clinical practice. The development of the Sport Concussion Assessment Tool-3 (SCAT3) provides a strong framework for evaluating concussion by amalgamating well-defined symptom measurements. The current research proposes to evaluate the clinical utility of the SCAT3 across time and to define its normative baseline values in a cohort of varsity athletes at the University of Toronto. Athletes will be tested on the SCAT3 during preseason training, on the sideline after sustaining a concussion, 3-5 days post-injury, and 3 weeks post-injury. A group of healthy, matched control athletes will complete the equivalent testing paradigm. Current baseline data suggests that symptom severity is significantly higher in athletes with a learning disability, $t(180)= 2.6$, $p< 0.05$, or diagnosed with a psychiatric disorder, $t(180)= 4.8$, $p< 0.01$. It is anticipated that although the SCAT3 will be both sensitive and specific in diagnosing concussion on the sideline, it will become less sensitive and specific in evaluating concussion as time post-injury extends. The proposed study will add to the field of knowledge on the psychometric properties of the SCAT3, consequently providing clinicians with a more objective account of its utility in evaluating concussions.

46. Higher Aggression and Mania on Behavioural Measures correspond to Lower White Matter Integrity in Related White Matter Tracts in Retired Professional Football Players: Implications for Treatment

R Green1,2, A Terpstra1,2, M Dabek1,2 C Tator2,3, B Colella1

1 Toronto Rehab-UHN; 2 University of Toronto; 3 Toronto Western-UHN

The primary objective of the current study was to differentiate the cognitive and neuropsychiatric functioning of retired professional football players with a history of multiple concussions from healthy controls. A secondary objective was to assess group differences in functional connectivity between the anterior temporal lobe (ATL) and orbitofrontal cortex (OFC) - brain regions associated with impulse control and emotion regulation - and whether the functional connectivity of these structures was related to the behavioural findings. On the behavioural measures, athletes had faster reaction times and an increased error rate on a go/no-go task and increased aggression and mania compared to controls. MRI revealed that the athletes had (1) cortical thinning of the anterior temporal lobe; (2) negative correlations of orbitofrontal cortex thickness with aggression and task errors, indicative of impulsivity; (3) negative correlations of UF axial diffusivity with error rates and aggression; and (4) elevated resting-state functional connectivity between the anterior temporal lobe and orbitofrontal cortex. These results suggest that a history of multiple concussions may relate to greater aggression and mania as well as structural and functional changes in related brain regions.

47. Higher Anxiety Predicts Greater Hippocampal Atrophy after Moderate to Severe Traumatic Brain Injury: Implications for Treatment

AR Terpstra1, TA Girard2, B Colella1, REA Green2,3

1 Toronto Rehabilitation Institute - UHN; 2 Department of Psychology, Ryerson University; 3 Department of Psychiatry, University of Toronto

In mild cognitive impairment (MCI) and early Alzheimer's disease, greater anxiety and anxiety-related affect are related to increased atrophy of brain structures involved in memory and emotion, including the hippocampus. The hippocampus is also highly vulnerable to damage following moderate to severe traumatic brain injury (TBI), although no previous study has examined anxiety's role in hippocampal atrophy with this group. Therefore, the current study examined in 84 individuals with chronic moderate to severe TBI whether higher anxiety on the Beck Anxiety Inventory at 5 and 12 months post-TBI predicted greater degeneration of the hippocampus from 5-12 and 12-30 months post injury, respectively. Results showed that higher anxiety was significantly related to greater volume loss in the right hippocampus, particularly the head. These results suggest that the screening, management, and treatment of anxiety after moderate to severe TBI may protect the brain in the chronic stages of injury and help promote recovery. Candidate treatments for anxiety in this group include cognitive behavioural therapy, which we have shown to be effective for anxiety in chronic acquired brain injury patients; and mindfulness meditation, for which we have demonstrated feasibility and will investigate its efficacy for reducing anxiety and atrophy in future research.

48. Maintenance of Hippocampal Volume Post-Traumatic Brain Injury via Spatial Navigation Tasks

A Baba1, M Hebscher1, Z Belchev1, J Ozubko4, A Gilboa1,2,3, B Colella5, R Green1,5

1 University of Toronto; 2 Rotman Research Institute; 3 Baycrest Centre for Geriatric Care; 4 State University of New York, Buffalo; 5 Toronto Rehabilitation Institute - UHN

Traumatic brain injury (TBI) has been shown to cause atrophy in the whole brain of individuals, particularly in the hippocampus; this has resulted in a decline in cognitive functions such as memory and spatial awareness. We have evidence that disuse may cause shrinkage of the hippocampi – the memory structures of the brain – and moreover that this shrinkage may hinder memory recovery. Therefore, ongoing "use" should logically help to maintain hippocampal volume. Evidence for the relationship between stimulation and maintenance of hippocampal volume in the context of neurodegeneration is found in the mild cognitive impairment / Alzheimer's disease literature. This line of research shows that ongoing selective activation of the hippocampi during a visuospatial memory task is associated with greater volume and less deterioration. Therefore, we are developing a memory intervention that is focused on selectively activating the hippocampus at a high enough intensity to confer benefits. The memory intervention will involve a spatial navigation stimulus created with Google Maps, which the participant will use to spatially navigate through various routes. The study hypothesis is that individuals who utilize the spatial navigation task will experience improved cognitive and memory functions, as well as demonstrate preservation of hippocampal integrity and volume.

49. Face to Face, Internet-Based and Group Based Treatments for the Spectrum of TBI

LA Ruttan1, B Colella1, S Lombardi1, L Meusel1, RE Green1

1 Toronto Rehabilitation Institute – UHN

People with traumatic brain injury can have enduring consequences, whether they have sustained a moderate-severe brain injury, multiple concussions or even a single concussion. We are using a multifaceted approach to (i) improve mood and cognitive symptoms after traumatic brain injury, and (ii) mitigate downstream brain atrophy. Therapeutic approaches include: 1) a concussion education support group, a two-night educational workshop for those coping with the enduring effects of a single or multiple concussions, and 2) group-based combination therapy, both in-person and on-line. The combination therapy protocol is 20-weeks long, comprising goal-management training (9 weeks), cognitive behaviour therapy (11 weeks), and environmental enrichment (i.e., intensified cognitive stimulation), running concurrently through the full 20 weeks. To date, we have run 5 support groups (upwards of 100 patients) and both face-to-face and internet-based combination therapy. We present in this poster a description of the interventions and our preliminary findings which include improved mood – in particular stress and reduced executive dysfunction in our combination therapy groups, and good feasibility (high participation and retention rate; positive appraisals) for our Education/Support workshops.

50. Scaling up: Province-wide Research and Clinical-care for Patients in the Chronic Stages of Traumatic Brain Injury

G Noack1, B Colella1, RE Green1, 2

1 Toronto Rehabilitation Institute; 2 Department of Psychiatry, University of Toronto

Through over a decade of basic and applied research we have identified clinical targets, interventions and approaches for the remote delivery of services to TBI patients. The next phase of our program is the ongoing refinement and proof of effectiveness of our interventions, and the standardization of intervention protocols to make recommendations for best practices. Most importantly, we are working to scale up of delivery of our interventions across the province to effectively reach the tens of thousands of patients contending with disability in the chronic stages of TBI; often individuals have been enduring impairments and their consequences for decades. To achieve this new scale of clinical services, we are creating new infrastructure: a centre that will bring together all of our evidence-based interventions, and will enable patients from across the province to receive the benefits of these interventions through their participation in research. That infrastructure will enable us to collect “big” data to continue to understand the brain, and how we can better repair it. It will also help us to refine our delivery platform, enabling us to the deliver intensive, meaningfully contextualized, and customized interventions to patients on an unprecedented scale.

ABSTRACTS –COMMUNICATION TEAM (51 – 57)

Team Leader: Dr. Yana Yunusova

The Communication Team undertakes research to improve assessment and treatment of communication deficits related to dementia, stroke, traumatic brain injury, and Parkinson's disease. The team members have developed novel therapies to improve naming in those with aphasia, and speech articulation skills and emotional communication in those with Parkinson's disease. They have developed interventions to maximize communication between caregivers and individuals with dementia, and are creating intelligent robots that can understand the needs of those with dementia. The team also addresses issues of age-related hearing loss by improving the design of hearing aids and their acceptability by older adults.

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51. KASPAR: Knowledge Base, Action Presenter, Sensor Module, Partially Observable Markov Decision

H Guo1, H Lin1, O Chen1, HR Chinaei1,2 , A Camacho1, H Zare2, F Rudzicz1,2, S McIlraith1

1 University of Toronto, Department of Computer Science; 2 Toronto Rehabilitation Institute

Dementia is a brain disorder that affects more than 35 million people worldwide, compromising their ability to perform basic activities of daily living. Social isolation affects many people with Alzheimer's Disease, which can exacerbate/accelerate their cognitive decline. Two reasons for social isolation are: limited availability of support staff and complexity of human communication. Personal assistive technologies are viewed as a promising means of supporting dementia sufferers. KASPAR is a proof-of-concept assistive technology that verbally guides patients through a common picture description task. KASPAR is designed to be customizable to particular patients and tasks. Thus, specifics of the patient, task, and session are stored in knowledge bases (KBs) which are accessed by other system modules. The Picture KB records the objects and relations in the picture. The Patient KB stores patient information, such as demographics. The Session KB stores the status of the conversation: objects and relations mentioned, expected responses, and emotional estimations about the user. KASPAR is currently embodied in a robot augmented with an external microphone and laptop computer. We model KASPAR's dialog system as a Partially Observable Markov Decision Process which chooses the optimal action to perform based on its belief of the patient's current cognitive state.

52. Postcard Memories: Analysis of Preliminary Usability Studies of a Mobile Postcard Application Geared Towards Adults with Early Stage Dementia

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This study investigates the benefits of creative activities using a touchscreen tablet prototype application entitled 'Postcard Memories', which is geared toward adults with early-stage dementia. A preliminary study using thematic video analysis revealed that participants found it meaningful to create and share digital postcards with media attached (i.e. video, audio, music, photos). Supporting this finding were results from semi-structured interviews, which were coded using grounded theory methodology. Most participants said photos helped them recall and retain memories. They said digital postcards were more efficient and enjoyable to create than traditional paper postcards, although most said there would be benefits from receiving paper postcards through the mail in tandem with digital postcards. Self-administered survey results parallel these findings: participants found adding media to the digital postcards to be the most meaningful aspect of the application.

These findings provide a rich account of the use of Postcard Memories as a way to engage participants in recalling experiences, sharing those memories with family and friends, and adding different media to enrich the experiences they shared.
Refinements have been undertaken with the results of the preliminary study. The application is now ready to test with our target audiences.

53. The Loss of Meaning in Semantic Dementia: Memory and Language Patterns

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1 University of Toronto; 2 Toronto Rehabilitation Institute – UHN; 3 University of Ottawa; 4 Toronto Western Hospital – UHN; 5 Sunnybrook Health Sciences Centre; 6 Baycrest Centre

Global coherence is necessary to sustain the continuity of discourse. Many studies have investigated coherence in discourse and have developed protocols to evaluate changes in discourse production (e.g. Reese et al., 2011; Arbuckle & Gold, 1993; Ulatowska et al., 2013). The coherence of discourse in semantic dementia (SD), however, has received scant attention in the literature. This study investigates discourse coherence in 8 semantic dementia patients and 8 matched controls.
Participants were administered a protocol and asked to report personal events. Their answers were transcribed and segmented. The content of the segmented units was analysed to measure its relevance to the event description on a scale from A to D, in which A is given to a unit conveying a message spatially or temporally contained in the episode, and D is given to a unit devoid of content.
Independent samples t-tests showed that patients produced significantly less information spatially and chronologically contained within the episode and significantly more information unrelated to the topic. The reason why the SD patients were less able to stay on topic remains to be investigated. Future studies will incorporate an investigation of episodic memory versus semantic memory in SD patients.

54. Monitoring Treatment Change in Developmental Motor Speech Disorders

A Huynh1, V Law1, AK Namasivayam1, NY Chui1, D Hayden2

1 Oral Dynamics Lab, Department of Speech-Language Pathology, University of Toronto; 2 The PROMPT Institute

Probe word scoring systems (PWSSs) are used to monitor degree of change toward specific therapy targets in developmental motor speech disorders. PWSSs fall into three categories: (a) auditory-perceptual (transcription-based) (Maas, Butalla, & Farinella, 2012), (b) motor-speech (visual) (Dale & Hayden, 2013) and (c) auditory-motor (combination of transcription and motor-speech) (Strand et al., 2006). In spite of its popular use among speech-language pathologists (S-LPs), the sensitivity of different PWSSs to treatment change has not been investigated. In this poster, we use pre-post treatment data from a child with speech sound disorders (SSDs) to assess the sensitivity of different PWSSs. 3 S-LPs blinded to the study purpose and pre-post session; each used a different PWSS to analyze the same child. A two-tail z-test ($\alpha = 0.5$) and effect size (Cohen's h) was calculated. The results indicated that none of the PWSS procedures tested provided significant differences for pre-post test scores despite a clinically relevant change noted in articulation and functional communication. This suggests the lack of sensitivity of such procedures in assessing subtle treatment change in children with SSD and motor speech disorders.

55. Oro-Facial Tactile Cues Improve Phoneme Recognition

V Law1, A Huynh1, AK Namasivayam1, T Yan1, R Bali1, D Hayden2, P van Lieshout1

1 Oral Dynamics Laboratory, University of Toronto, Department of Speech-Language Pathology; 2 PROMPT Institute

In motor-based speech treatment approaches a speech therapist may provide multi-sensory (tactile-kinesthetic-proprioceptive {TKP}, auditory and visual) cues for improving speech production. However, we do not know whether these exogenously delivered TKP inputs can also be utilized by the cognitive-linguistic system to facilitate phoneme perception and word retrieval. We explored the effectiveness of exogenous TKP inputs for improving phoneme recognition in both high- and low-frequency spoken words. Congruent (matched sound and tactile cue) and incongruent (mismatched sound and tactile cue) TKP inputs were administered to 23 native English speakers by an experienced speech therapist specializing in motor-based treatment. Results indicated a significant main effect of congruency ($p=0.04$), and a significant advantage for congruent TKP priming in low-frequency words ($p=0.01$) compared to high-frequency words ($p=0.77$). This finding may suggest that the influence of TKP inputs on pre-lexical selection is biased by the usage sensitivity of how lexical information is stored in the mental lexicon (Luce & Pisoni, 1998). Overall, these results corroborate with recent findings that suggest neural processing of speech broadly integrates event related information across multiple modalities (such as auditory, tactile, visual, etc.), and that exogenous TKP inputs may affect phoneme perception in spoken words (Derrick & Gick, 2010).

56. Speech Intelligibility in Parkinson's Disease

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Intelligibility has frequently been used to index the severity of speech disorders and as an outcome measure to document the success of speech treatment. It is known that Parkinson’s disease (PD) affects speech intelligibility as disease progresses; however, knowledge of the effect of common therapeutic interventions (e.g. rate, loudness, and style) is lacking. This study aimed to capture differences in scaled intelligibility for individuals with PD compared to healthy adults (HA) across a range of speaking conditions. Sentences produced at normal, loud, clear, and slow styles were recorded from twenty HA subjects and sixteen PD subjects. 37 listeners completed a practice session, then were played-back sentences mixed with speech-shaped noise, and asked to rate the stimuli relative to the assigned modulus in a direct magnitude estimate task. The results indicated that scaled intelligibility was reduced in PD speakers relative to HA speakers. In addition, both HA and PD speakers showed increased intelligibility when prompted with speaking style instructions. The largest intelligibility increase occurred in the clear condition which supports using it as a treatment technique in PD patients. The results also leads to interesting hypotheses regarding the effect of speaking conditions on speech movements and their relationship to speech intelligibility.

57. Arts-Based Interventions and Parkinson's Disease

D Fanelli1, E Vezer1, S Livingstone1,2, S Hutchins3, FA Russo1,2

1 Ryerson University, Department of Psychology; 2 Toronto Rehabilitation Institute; 3 The Royal Conservatory of Music

A large part of successful interpersonal communication relies on both the production and accurate interpretation of vocal and facial expressions. Both of these abilities appear to be impaired in people with Parkinson's disease (PD), a neurodegenerative disease that affects the muscles of the body and results in motor symptoms that include blunted facial expressions and decreased vocal quality. Based on previous research supporting the positive effects of rhythmic auditory stimulation (RAS) on overall motor functioning, the present study will investigate the impact of two arts-based programs on emotional communication in people with PD. A group of 14 PD patients enrolled in a choir program and a group of 14 PD patients enrolled in a dance program will be tested prior to, immediately after and two months after the completion of their respective programs on measures of facial expressiveness, emotion perception and vocal ability. Given the greater focus of choral singing on vocal and facial muscles, it is hypothesized that subjects in the choir program will demonstrate more marked improvements on all measures than those in the dance program. Therapeutic gains may lead to improvements in overall emotional health, addressing issues common in PD such as anxiety, depression, isolation and reduced quality of life.

ABSTRACTS – HOME, COMMUNITY & INSTITUTIONAL ENVIRONMENTS TEAM (58 – 65)

Team Leader: Dr. Tilak Dutta

The Home, Community and Institutional Environments Team develops technologies to help older adults and individuals with disabilities live more safely and independently by preventing falls and ensuring safe mobility. They also develop technologies to help caregivers prevent back injuries and the spread of infection. The team implements their goals by bringing successful new products to the market, making important changes to policy or introducing new therapies to clinical practice.

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58. ToiLocator

A Badzynski1, S Pong1, A Sobchak1, P Holliday1, G Fernie1, T Dutta1

1 Toronto Rehabilitation Institute

The ability to get on and off the toilet can mean the difference between living at home and having to move into long-term care for frail older adults. Osteoarthritis, affecting over 7 million people in the US and Canada, is very common in those who are frail, making it difficult for them to use a standard-height toilet.

We have developed a device, which would allow the toilet to be repositioned in any given bathroom to make it more accessible, as well as raising the height of the toilet. A waste pipe extends from the toilet towards the bathroom's original waste pipe as to avoid a renovation of the bathroom layout. In its new position, there is enough space for the user to approach with an assistive device and for a caregiver to assist the user without adopting extreme postures.

The toilet relocating device will be an economical alternative to a more costly bathroom renovation or need for institutional care, which may otherwise be required, and makes even temporary installation and removal possible without any damage to the bathroom. We have planned a series of focus groups with older adults and home caregivers to show a first set of prototypes of the device and receive feedback.

59. PostureCoach: A Wearable Feedback System to Prevent Back Injury

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1 Toronto Rehab - UHN; 2 Department of Kinesiology, McMaster University; 3 Institute of Biomaterials and Biomedical Engineering, University of Toronto; 4 Department of Computer Science, University of Toronto; 5 Saint Elizabeth; 6 Department of Mechanical and Industrial Engineering, University of Toronto

Healthcare workers are the most frequently injured workforce in Ontario, and low back injuries are the most common type of injury. Movement-centered feedback has been shown to be effective in reducing spine loading and injury incidence during lifting and lowering tasks, but conventional approaches are typically expensive and not portable. We have developed PostureCoach, a low-cost, wearable posture assessment and coaching system. PostureCoach tracks spine motion using orientation sensors embedded into a wearable vest and belt. The sensors link wirelessly with a custom smartphone app that can calculate the user's low-back angle, which is a strong indicator of injury risk. The smartphone vibrates to alert the user when their posture is unsafe. In a lab-based assessment study, we found that PostureCoach tracks spine angles to within ±5° of Vicon optical tracker measurements. PostureCoach is currently being tested in homecare and institutional environments in collaboration with VHA Home HealthCare, Saint Elizabeth, UOIT, and University of Toronto occupational therapy training programs. We are preparing for commercialization of the technology. PostureCoach will improve caregiver's

patient-handling techniques and reduce low back injury rates for this vulnerable population. We will demonstrate that the system can teach caregivers to self-identify and habitually practice safer postures.

60. Design of a Balance Recovery Training Device for Older Adults

S Wiebe1,2, T Dutta1,2, G Fernie1,2

Toronto Rehabilitation Institute1; University of Toronto2

There are more older adults than children in Canada, and this trend will continue as the last of the baby boomers reach the age of 65. The Government of Canada estimates that 20-30% of older adults fall each year. Falls are the leading cause of unintentional injuries in Canadian seniors, accounting for $6.2 billion, or 31% of total costs of injury. Perturbation based balance training (PBBT) is a novel approach that focuses on retraining balance recovery actions. PBBT has been demonstrated as effective in training recovery actions in older adults. Additionally, subjects report improved confidence in their mobility. PBBT involves repeatedly causing users to unexpectedly lose their balance to permit practice of recovery actions. There is an inherent risk of falling which is mitigated by a harness and support structure. This research is focused on the design and prototyping of a self-directed balance-recovery-action training system for use by older adults in residential settings. The goal is to design a device that: (a) prevents the user from injurious falls (b) causes irregular/unexpected loss of balance eliciting balance recovery actions (c) easy to use and (d) fun! The design will be analyzed, fabricated and then undergo pilot testing with experienced PBBT users.

61. Improving Handrail Height Requirements for Preventing Falls during Level-Ground Walking and Ramp Descent

V Komisar1,2, AC Novak1, M Jabakhanji1,2,3, EC King1,4, BE Maki1,2,5,6, KF Zabjek1,7, GR Fernie1,2,5,6

1 Toronto Rehabilitation Institute – University Health Network; 2 Institute of Biomaterials and Biomedical Engineering, University of Toronto; 3 Division of Engineering Science, University of Toronto; 4 Department of Mechanical and Industrial Engineering, University of Toronto; 5 Department of Surgery, University of Toronto

6 Institute of Medical Sciences, University of Toronto; 7 Department of Physical Therapy, University of Toronto

Motivation: Handrails are low-cost installations that can significantly enhance balance recovery and reduce the risk of a fall, provided that they enable fast, accurate and effective reach-to-grasp reactions. However, the consequences to reach-to-grasp when handrails are too high or too low are not well-understood. This project investigates how handrail height affects the speed, accuracy and effectiveness of reach-to-grasp reactions in younger (YA) and older (OA) adults during level-ground walking and 8^{o}-ramp descent.

Methods: Eighteen YA and eighteen OA walked beside a handrail in Toronto Rehab's Challenging Environments Assessment Laboratory. Handrail height was varied (30"-44"/76.2-111.6cm). Participants were destabilized via walking-surface perturbations, which evoked reactive grasping. Videos were analyzed for hand-handrail collision likelihood (hand collides with handrail before grasp achieved). Kinematic, kinetic and electromyographic data were also collected.

Initial results: Hand-handrail collision likelihood was highest with lower rails (30"-32"). The handrail heights with the lowest reach-to-grasp collision likelihood were at or exceeded the upper Ontario building code boundary for ramps and care facility corridors (42"-YA-level; 44"-OA-level and YA-ramp; 38"-OA-ramp). This implies that the current upper boundary may warrant re-exploration.

Significance: Further evidence from this project will inform Canadian handrail standards, thereby helping to promote safer mobility and reduce falls risk in the community.

62. The Relationship between Handrail Shape and Balance Recovery

P Gosine1,2, V Komisar1,2, B Maki1,2,3,4, G Fernie1,2,5,6, A Novak1

1 Toronto Rehabilitation Institute; 2 University of Toronto, Institute of Biomaterials and Biomedical Engineering; 3 University of Toronto, Department of Surgery; 4 University of Toronto, Institute of Medical Science; 5 University of Toronto, Department of Rehabilitation Science; 6 University of Toronto, Department of Mechanical and Industrial Engineering

Introduction: The most effective way to arrest a fall on stairs is with handrail use. However, the effect of handrail shape on balance recovery has not been studied under dynamic conditions. The purpose of the study is to determine allowable handrail shapes to facilitate balance recovery during ongoing stair descent.

Method: Unpredictable perturbations will be used to destabilize participants during stair descent and induce balance recovery reactions. Fifteen younger and fifteen older adults will participate. Several handrail shapes and sizes will be investigated including: (a) circular, (b) decorative (Type-II), and (c) rectangular handrails. Kinematic and kinetic analyses will be used to quantify the effectiveness of each handrail cross-section for balance recovery during (1) proactive handrail use, and (2) a reach-to-grasp situation.

Expected Results: We expect that, while circular handrails will be optimal, small-diameter Type-II handrails will be acceptable. We hypothesize that rectangular and large-diameter Type-II handrails will not allow generation of adequate forces for effective grasping following balance loss and these differences will be amplified for older adults.

Significance: This research will generate quantitative evidence to inform the Canadian Building Code, with the goal of creating safer handrail standards for preventing falls on stairs.

63. IMU-Based Motion Capture System (XSENS) Accuracy in CEAL

B Leaker1,2, Y Li1, T Dutta1,3

1 Toronto Rehabilitation Institute; 2 University of Toronto, Division of Engineering Science; 3 University of Toronto, Department of Mechanical and Industrial Engineering

Background: The current gold standard for 3D motion capture are optical multiple-camera systems such as Vicon or Motion Analysis that require large open spaces as well as a considerable amount of post-processing. Wearable inertial measurement unit (IMU) based motion capture systems such as XSENS offer attractive alternatives by reducing both space and post-processing requirements. However, there are concerns over the accuracy of these systems, particularly in areas with high magnetic interference.

Objective: Determine the accuracy of the XSENS system in the Challenging Environment Assessment Laboratory (CEAL)

Methods: Gait data was simultaneously collected with the Motion Analysis system and the XSENS system. Kinematic gait parameters were determined with both data sets and the root-mean-square deviations (RMSD) were calculated.

Results: XSENS systematically underestimated foot angle (RMSD=3.9°) and step length (RMSD=6.8cm) but accurately determined the timing of events, with a step time RMSD of 8.8ms. The global coordinate system of the XSENS system shifted laterally 1.5m over a 5 minute interval and the drift of the legs with respect to the pelvis over that period was 2.5°.

Conclusion: The validity of IMU-based systems is highly dependent on the intended application, in terms of both the recording environment and movement to be measured.

64. A Model Predictive Control Based Motion Drive Algorithm for 6 Degree-of-Freedom Hexapod Motion Base for the CEAL Driving Simulator

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1 Toronto Rehabilitation Institute, 2 University of Toronto Institute for Aerospace Studies

The past 50 years have seen major advances in the simulation technology. Sophisticated simulation hardware and increased computational resources have enabled accurate reproduction of visual and auditory cues. However, with limitations on the simulator workspace, it is almost impossible to have a one-to-one relationship between the real-world motion cues and those in the simulator. A motion drive algorithm (MDA) aims at minimizing the difference between perceived acceleration in the vehicle to that in the simulator. It is desired that the motion cueing strategy best exploits the available workspace while avoiding false cues and eliminate the motion cues that lead to motion sickness. Washout filters are one of the most widely used motion drive algorithms, however, tuning a washout filter can be challenging and may require expertise and significant experience as the filter tuning parameters are non-intuitive [1]. This research aims at developing a model predictive control (MPC) based motion drive algorithm. MPCs ability to perform a constraint optimization on a finite horizon [2] can maximize the use of simulator workspace. In addition, the tuning parameters of a MPC are intuitive, platform limitations are mathematical constraints in the equations of the controller and penalties on false cues and motion sickness can be incorporated in the optimization cost function.

65. "Rebuilding Lives with Rehabilitation Engineering": A summer program for inspiring student interest in rehabilitation research

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Motivation: We developed and led a week-long course on rehabilitation engineering to 25 high school students through the University of Toronto's DEEP Summer Academy. This course aimed to motivate students to pursue rehabilitation engineering and develop novel technologies that help others to successfully age-in-place.
Foundation Activities: Students gained scientific context through lectures and iDAPT tours at Toronto Rehab. Guest speakers included Toronto Rehab researchers and a previous patient, which helped to legitimize the discussed challenges associated with disability. Our experiential approach to learning also included disability simulations at UofT for students to appreciate common yet unexpected challenges, and a small-scale accessible design challenge to demystify prototyping and consolidate their experience.
Culminating Engineering Design Challenge: Students followed an engineering design process to design a finger cast for individuals with Rheumatoid Arthritis, using computer-assisted design and TRI's 3-D printer to make their prototypes. Five out of six teams were able to wear their respective finger casts successfully. Students were very excited to see their ideas come to life.
Significance: Positive student feedback demonstrated that students understood the importance of rehabilitation engineering, and were excited by their potential to contribute to designing solutions that mitigate challenges associated with disability.

65a. Bedsore Prevention: A Novel Prompting System for Patient Repositioning

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This abstract has been withheld to avoid public disclosure of confidential information.

ABSTRACTS –ARTIFICIAL INTELLIGENCE & ROBOTICS IN REHAB (AIRR) TEAM (66 – 74)

Team Leader: Dr. Alex Mihailidis

Toronto Rehabilitation Institute's mission is to deliver safe and effective patient care. The focus of the Artificial Intelligence & Robotics in Rehab (AIRR) team is to improve the quality and cost of care by providing tools that can support the roles and practices of caregivers and clinicians. A primary objective of the team is to develop advanced technologies that can deliver this care anywhere and at any time, whether in a hospital, clinic, or in the home. These technologies use advanced techniques and algorithms from the fields of artificial intelligence, robotics, computer vision, and pervasive computing. The AIRR team implements solutions that actually help improve the delivery and outcomes of rehabilitation and healthcare in order to help older adults and individuals with disabilities live more independently.

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66. Passive Physiological Monitoring via Ambient Sensors Embedded in a Home Environment

SJI Chang1,2, A. Arcelus2, J. Boger2,3, J. Qiu4, A. Mihailidis1,2,3

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Issues with the current wearable form of residential medical monitoring devices include forgetting to wear the device and/or using the device incorrectly. One approach to counter these problems is to use ambient monitoring, where sensors embedded into the environment measure signals unobtrusively with little or no user effort. The passive monitoring devices – the floor tile, the chair, the blanket, the bed, and the thermal camera – were evaluated on older adults with heart failure. Preliminary analysis of one subject showed that the bed could measure the weight pressed on each leg via load cells installed at the end of each leg. Ballistocardiogram from the chair was clean as the posture of the subject was more stable. The integrity of signals from the blanket (i.e. 2D array of 16, 3-axes accelerometers) was good. The smart floor showed noisier ballistocardiogram compared to the chair but nonetheless was able to collect a usable signal.

67. New Intelligent Assistive Technology Algorithms to Detect Behavioral Symptoms of Dementia

B Chikhaoui1, B Ye, A Mihailidis1

1 IATSL Lab, Toronto Rehab Institute

Caring for a rapidly aging population constitutes a challenging healthcare issue. Existing assistive technology systems lack the ability to automatically detect aggression and agitation in older adults with dementia and predict their occurrence. These behaviors include actions that disrupt care and safety, such as wandering, physical and verbal aggression, and treatment refusal. They can cause enormous suffering for people with dementia and stress on caregivers. If they are left untreated, aggressive and agitated behaviors can result in reduced functions of people with dementia, high levels of caregiver burden and stress, and diminished quality of life. Our research intends to develop a predictive system that is able to detect and identify aggressive and agitated behaviors in people with dementia. The system will be able to predict that a person may become aggressive and then report this information to the caregivers of people with dementia. The proposed system will be of great value to the caregivers

and people with dementia. It will help reduce the burden of the caregivers and ensure the well-being of people with dementia.

68. A Table Docking Location Detector for the Powered Wheelchair Parking Assistance Reactive Co-pilot (PARC)

G Foley1,2,4, P Viswanathan1,3,4, A Mihailidis1,2,3,4

1Toronto Rehabilitation Institute; 2 Institute of Biomaterials & Biomedical Engineering, University of Toronto; 3 Department of Occupational Science & Occupational Therapy, University of Toronto; 4 AGE-WELL Network of Centres of Excellence

For mobility impaired individuals who are unable to self-propel in manual wheelchairs, a powered wheelchair is essential to leading an independent life. Some individuals who require a powered wheelchair to remain independent are denied access to powered mobility due to safety concerns arising from cognitive, sensory or physical impairments. Loss of independent mobility leads to decreased quality of life by reducing social interactions and the ability to independently carry out activities of daily living. Intelligent powered wheelchairs, powered wheelchairs equipped with sensors and an on-board computer, can enable potential powered wheelchair users by providing collision avoidance and navigation assistance. Despite extensive research and development conducted on intelligent powered wheelchairs, investigation of context-specific driving tasks, where the user needs to get closer to objects, has been limited. Docking at a table is a common yet challenging driving task for powered wheelchair users which requires context awareness. A table docking location detector has been developed using a Microsoft Kinect and the Robotic Operating System. Preliminary results show the detector correctly identifies safe docking locations under realistic conditions (clutter on and underneath table). Areas which require improvement include detection in the presence of partial occlusions in front of the table and small obstacles near the ground.

69. Technology, Design and Dementia: Views from People with Dementia

T Jiancaro1,2,3, A Mihailidis2,3,5

1 Rehabilitation Sciences Institute, University of Toronto; 2 Institute of Biomaterials and Biomedical Engineering, University of Toronto;3 Toronto Rehabilitation Institute-University Health Network, Toronto;4 Dept of Occupational Science and Occupational Therapy, University of Toronto

Despite the rising prevalence of dementia in Canada and around the world, little is known about the design of everyday technologies for people with this condition. Given the need for effective in-home support, this is a dire problem. To address this problem, we have investigated various design issues, including the needs, challenges and strategies associated with the use of everyday home technologies for this population. Unique to the project is its 360° perspective, which includes the views of developers, caregivers, and, crucially, people with dementia. To investigate the experiences and views of users, we conducted a demonstration study in participants' homes. Participants included people with dementia (n=7) and their family member caregivers (n=7). Challenges emerged involving phone use in particular, including: difficulties selecting the correct button, menu listing, action and sequence of numbers. These issues represent important topics for developers to consider in their analysis and crucially, in their prototype designs.

70. Can Severe Upper extremity Hemiplegia Improve with Functional Electrical Stimulation?

DA Hebert1,2, I Antunes1, JM Bowen3,4, DJ O'Reilly3,4, R Virji5, A Ghori5, E Tang5 S Shatil6, N Katsouras7, M Bayley1,2

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People who have had a stroke resulting in low levels of arm and hand function (i.e. Chedoke -McMaster Stages of Motor Recovery Levels 1 and 2) are considered unlikely to make significant functional gains with upper extremity intervention. MyndMove™, a new technology, offers 17 different electrical stimulation protocols to treat the upper extremity in functional patterns such as reach and pinch. This open label study examined the effectiveness of using MyndMove™ with people with stroke who had low levels of recovery in both sub-acute and chronic phase of recovery. This poster focuses on the chronic cohort results. Subjects: Twenty-four patients with Chedoke-McMaster Stages of Motor Recovery 1 and 2, and greater than 6 months post stroke completed the study. Method: Participants completed 19 or 20 sessions using 1 - 4 protocols of the MyndMove™ technology. Pre and post - testing utilized the Fugl-Myer Upper Extremity assessment. Results: A minimal clinically important difference (>5 point increase) in Fugl-Myer Upper Extremity assessment was observed in 14/24 (58%) participants. Changes ranging from decreased tone to improved ability to do functional tasks were reported. Conclusions: The MyndMove™ technology shows promise in improving upper extremity function in the chronic phases of stroke recovery with people with low level motor return.

71. Building a Synthetic Training Dataset for an Intelligent Fall Detection System

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Falls are the most common cause of injury in older adults, making fall detection systems extremely valuable. Some intelligent fall detection systems can detect falls after being trained on annotated images of people falling and not falling (performing everyday actions). In general, intelligent systems like this tend to perform better with more training data. However, it is time consuming to create large, real datasets. One way to speed up this process is to use a synthetic dataset. Our objective is to generate a large synthetic training dataset using the game engine, Unity. By training on a larger dataset, our goal is to increase the accuracy of a fall detection system. In Unity, a "game" was designed where an avatar is animated falling and doing everyday actions in a virtual HomeLab. Annotated screenshots of the "game" were taken and used to build the dataset. To validate this method of training, the fall detection system will be trained on both real and synthetic datasets of the same size, and the trained classifiers will be tested on real data. We will also investigate the effects of increasing the size of the synthetic dataset and training with a combination of real and synthetic data.

72. Portable Wrist Pronation and Supination Robot for Stroke Rehabilitation

A Yurkewich1,2,3, P Weiss1,5, R Wang1,2,4, B Ye1,2,4, D Hebert1, A Mihailidis1,2,3,4

1 Toronto Rehabilitation Institute; 2 University of Toronto; 3 Institute of Biomaterials and Biomedical Engineering; 4 Department of Occupational Science and Occupational Therapy; 5 University of Lubeck - Institute of Computer Engineering

Introduction: 50,000 Canadians experience a stroke each year and half do not recover the fine wrist and finger function necessary to perform daily activities. Through guided daily exercise that adapts the challenge level regularly, this function can be regained. Portable in-home robots can provide this daily guidance by assisting and resisting stroke survivors as they perform their exercises independently and at home.
Objectives: The pertinent exercise, assessment and device design criteria were established for the development of an effective and affordable in-home stroke rehabilitation robot for the wrist and fingers.
Methods: A user-centred design approach was taken to develop a robot prototype that provided assistance and resistance during wrist pronation and supination exercises. 10 healthy participants, 4 occupational therapists, and 2 stroke survivors participated in a 60 minute usability study with the robot. Quantitative motion and torque data was captured during exercise and assessment tasks. Likert scale questionnaires and interviews were used to attain perspectives on feasibility and usability. **Results:** The quantitative data provided real-time assessment of wrist range of motion and strength. Qualitatively, patients were more positive than therapists about the usability of the current system, and both provided useful feedback to improve the exercise modes, and user interface.
Conclusions: The usability study provided meaningful information for continued iterative robot design.

73. Predicting Clinical Dyskinesia Scores From Head Motion Tracking

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Levodopa is commonly prescribed for the treatment of Parkinson's disease (PD) motor symptoms. However, prolonged usage of levodopa can lead to levodopa-induced dyskinesia (LID), another movement disorder marked by flowing and twisting motions. The standard assessment for levodopa-induced dyskinesia is the Unified Dyskinesia Rating Scale (UDysRS), composed of four tasks (communication, drinking from cup, dressing, ambulation) designed to measure levodopa-induced dyskinesia's impact on activities of daily living. Unfortunately, this assessment is time-consuming and inconvenient for both persons with PD and neurologists. It is also inherently subjective, as it relies on visual inspection of the individual by the neurologist to assign a rating of severity. To tackle these issues, an automated, non-contact system is proposed to assess dyskinesia severity using computer vision. In preliminary tests, head motions were tracked in clinical videos of PD assessment. Features related to movement velocity and frequency were extracted and used to predict UDysRS neck scores during the communication task. The system achieved a correlation of 0.87 with expert neurologist ratings.

74. Development of the AIRR Robotic System for Upper Limb Therapy Post-stroke

R Wang1,2, M Coahran2, C Ho2, D Hebert1,2, A Mihailidis1,2

1 University of Toronto, Department of Occupational Science & Occupational Therapy; 2 Toronto Rehabilitation Institute

Robotic systems for upper limb therapy can improve upper limb motor function and daily activity performance following stroke. Augmentative therapy with robotics offers activities that encourage therapy at higher intensities; quantitative measures to monitor performance changes; and an opportunity for therapists to focus on functional activities rather than repetitive tasks. Implementation of robotic therapy has been limited due to high technology costs and lack of knowledge on how to best integrate robotic therapy for optimal gains. The AIRR team with an industrial partner developed a low cost, portable robotic system. The system is currently undergoing evaluation at the Rocket Family Upper Extremity Clinic with stroke survivors with moderate upper limb mobility disability. The study examines usability of the system in a clinical setting (ease of use, satisfaction, feasibility, safety) and preliminary therapy effectiveness. Participants engage in a customized therapy program (e.g. 2 sessions x 10 weeks) following standardized comprehensive assessments. Post-program evaluation includes interviews and assessment re-administration. One participant has completed the study with positive outcomes for usability. A second is in process and another is being recruited. If shown to be usable in the clinical setting, we will progress to a larger multi-site trial to further evaluate therapy effectiveness.

75. Game Design Heuristics for Greater User Acceptance of Robotic Stroke Rehab

HT Chiam1, R Wang2,3, A Mihailidis1,2,3

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Background: Video games, appropriately designed, can engage and motivate stroke survivors to follow through with therapy exercises, hence improving outcomes. Supplementing conventional upper-limb therapy by combining games and robotics enables patients to continue without therapists constantly present for repetitive parts of therapy. Previous studies have used games simulating realistic activities ("unmasked"), non-realistic activities ("masked"), or no game or story overlay at all ("baseline"), but have not specifically addressed which design helps better maintain stroke survivors' motivation and adherence. There is no apparent consensus among therapists.
Objective: To compare three rehabilitation-game designs ("unmasked", "masked", and "baseline"), and determine aspects contributing to users wanting to play longer and receiving more exercise.
Methods: Exploratory mixed-methods design. Consulting stroke survivors and therapists generated game parameters and ideas. Three games requiring the same motions will be designed. Stroke survivors will test each game using an upper-limb rehabilitation robot. Game design aspects will be analysed using robot data, questionnaires, and observations to determine contributions to motivation, adherence time, and repetitions.
Significance: This study aims to identify each game's beneficial aspects for future game development. Future work will apply the findings to compare different games' outcomes in motor recovery and transferability to daily living activities.

ABSTRACTS –OPTIMIZATION OF THE REHABILITATION SYSTEM TEAM (76 – 85)

Team Leader: Dr. Kathy McGilton

If there is one word to describe Team Optimize, it is diversity: our scientists and trainees reflect a multiplicity of backgrounds and research interests including Clinical Epidemiology, Occupational Science, Physical Therapy, Geriatric Oncology, Medical Anthropology and Nursing. What we share is a goal to invigorate and extend the rehabilitation system in order to improve patient care. This rich and extensive background has contributed to the team's ability to perceive systemic gaps in the current health care system and to deliver ideas and products to address those gaps. Since much of our research is directly relevant to decision-makers, patients and clinicians, we often work with stakeholders to set the research questions through to dissemination of the research results.

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76. A Prospective Study of the Impact on Depression over 3 Years during Treatment with Intensive Chemotherapy in AML Patients

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Background: Acute myeloid leukemia (AML) is an aggressive malignant blood disorder in adults. The primary preferred therapy for newly diagnosed patients is intensive chemotherapy, which is associated with improved survival, but also significant toxicities, including depression. The prevalence of depression among patients with cancer is higher than the general population. Few studies have focused on depression in patients with AML. This study aimed to investigate the impact of intensive chemotherapy on depression over 3 years in a cohort of younger (<60 years) and older (60+ years) AML patients. **Methods:** AML patients undergoing intensive chemotherapy at the Princess Margaret Cancer Centre were enrolled in a prospective, longitudinal study. At the baseline assessment (pre-intensive chemotherapy), patients completed validated quality of life questionnaires in addition to 3 physical performance measures. Depression was measured using the 21-item Beck Depression Inventory (BDI) at baseline and at multiple time points over 3 years. Linear mixed effects models were used to evaluate change in depression score over time. Linear regression was used to evaluate predictors of change in depression score over 1, 2 and 3 years. For all statistical comparisons a p-value of 0.05 was considered significant. **Results:** 237 patients (140 younger and 97 older) were recruited. Overall mean BDI score was 10.5 (SD 6.7) at baseline, and was higher (worse) in younger patients (p=0.003). During intensive chemotherapy, BDI scores were stable in both younger and older adults (p>0.05). However, BDI scores significantly improved after intensive chemotherapy over 3-year follow up (p<0.05). Results show younger adults improved significantly more than older adults (p=0.005). In univariate linear regression baseline Charlson comorbidity score and creatinine were predictors of depression over 1 year. Baseline emotional functioning social functioning, cognitive functioning and global fatigue were significant predictors of depression over 1, 2 and 3-year follow up. (p=<0.05). In multivariate linear regression the Charlson score was the strongest predictor of change in 1-year depression. Only hemoglobin was a predictor over 2-year and emotional functioning over 3-year follow-up (p<0.05). **Conclusion:** Patients treated with intensive chemotherapy who achieved remission had improved depressive symptoms over

a 3-year period. Depressive symptoms were worse at baseline in younger adults but improved more than in older adults over time.

77. Who's the Boss? PSWs Wielding Informal Power Over Nurses in Long Term Care Homes

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Nurses (RNs, RPNs) supervise unregulated personal support workers (PSWs), who provide almost all direct care to residents in Long Term Care Homes. To date, the influence of PSWs on RN/RPN activities and supervision has not been examined. Qualitative interviews with 29 staff (3 administrators; 7 directors/supervisors; 5 RNs, 5 RPNs, 8 PSWs, and 1 Allied Health) across three Long Term Care Homes investigated factors influencing nurse supervision of unregulated staff. Results demonstrate PSWs operate as a cohesive occupational group to influence how nurses delegate care directives. When PSWs disagreed with nursing orders, they were uncooperative including failing to carry out requested tasks, and publicly questioning nurses. When PSWs perceived nurses held poor professional regard, PSWs with longer employment tenure convinced newer staff to ostracize individual nurses and disregard directives. RPNs who had once been PSWs were at particular risk of being challenged by PSWs. The outcomes of PSW challenges to the traditional nurse-PSW supervisory relationship, represents significant PSW informal power. Evidence of PSW group bullying of some nurses, especially those who had previously been PSWs, and the public challenging of nurses, demonstrates a negative side to PSW informal power. Interprofessional interventions are recommended to improve nursing work conditions, and ensure quality care.

78. Web-Based Health Interventions for Family Caregivers of Elderly Individuals: A Scoping Review

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Background: Family caregivers of elderly individuals often fail to utilize in-person support services due to time constraints and lack of transportation. This highlights the value of accessible web-based support interventions for this population. Existing reviews on web-based interventions focus on single illness populations and intervention efficacy. Thus, we have limited insight into the development, content and caregiver experience of web-based interventions across aging-related illnesses.
Objectives: To describe: a) the development, content and delivery of web-based interventions; b) usage of web-based interventions; c) experience with web-based interventions and d) the impact of web-based interventions on health and social outcomes.
Methods: University of York's framework for conducting scoping reviews.
Findings: 40 publications representing 20 web-based interventions were included. Interventions aimed to improve various health and social outcomes for caregivers by providing education and communication with peers and healthcare professionals. Overall, caregivers were satisfied with the usability and accessibility of the websites, feeling that online support was comparable to or better than in person support. Mixed findings in terms of how interventions impacted outcomes but improvements in burden were commonly observed.
Conclusions: Web-based interventions should be tailored to the caregiving population and circumstances. Standardized measures should be used to explore common caregiving outcomes.

79. Eliciting Dementia Research Priorities from Canadians

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1 Toronto Rehabilitation Institute; 2 University of Toronto, Lawrence S. Bloomberg Faculty of Nursing; 3 Alzheimer Society of Canada

In health research, there is recognition of the need to incorporate the experiences and insights gained from persons living with the health condition being studied. Recognizing the importance of this patient engagement, the Alzheimer Society of Canada is collaborating with the Canadian Consortium on Neurodegeneration in Aging on a process to elicit dementia research priorities from Canadians. The objective of the Canadian dementia priority-setting partnership is to identify the "top ten" dementia research priorities from Canadians with dementia, their friends/family/caregivers, health and social care providers and the public, and that this information be used to influence dementia researchers and research funders. Through such mechanisms, more research will be conducted in these priorities areas. This priority-setting project will employ the methods of the James Lind Alliance (JLA) and be overseen by a Steering Group. The methods include a cross-Canada survey, in collaboration with national, provincial and local Alzheimer Societies and other partners, seeking to engage people in different stages of dementia, their friends/family/caregivers and health and social care providers and the public. The research questions generated by this survey will be refined, systematically checked against current research evidence, and then prioritized through a two-stage process (including a final in-person workshop).

80. AGE-WELL and Transdisciplinarity: Advancing the Field of Aging and Technology

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To move the field of aging and technology forward, AGE-WELL requires a transdisciplinary research approach. In this type of approach scientists of diverse disciplinary backgrounds and individuals with experiential knowledge (e.g. industry, policy makers, end-users) collaborate together to solve a "wicked problem" (e.g. a problem that is complex, involves multiple stakeholders and can't be solved by a singular discipline or linear research approach). Transdisciplinarity embraces complexity and multiplicity and seeks to integrate knowledge across diverse stakeholders (e.g. scientists, engineers, academics, industry, government, professionals, and "regular community members"). This integration is thought to transcend individual perspectives and disciplines and produce more complete and holistic solutions. Adopting transdisciplinarity in the context of aging and technology is useful to ensure that developed technologies meet older Canadians' needs and are commercially viable. However, while transdisciplinarity is valuable for generating theoretical insights and innovation, supporting transdisciplinarity in practice can be challenging. In particular, it requires a culture change in the current way we think about and organize research. The aims of this presentation are to introduce transdisciplinarity and its key concepts, provide an overview of barriers and facilitators to this type of approach, and discuss how transdisciplinarity will be supported across AGE-WELL and beyond.

81. Tools for Assessing Clinicians' Knowledge in Pain Management: A Systematic Literature Review

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Background and objective: Despite all advances in pain research, around 50% of patients still suffer from unmanaged Chronic Pain (CP). Several reports have shown that such suboptimal care may be due to deficient knowledge among clinicians regarding CP management and opioid use. Due to the multifaceted nature of CP, there are a wide range of potential questionnaires used to assess clinicians' knowledge. The objectives were to identify and critically appraise existing tools to assess pain knowledge among clinicians.
Method: Electronic database searches from inception to July 2015: EMBASE, Medline, PubMed supp., CINAHL, and Health and Psychosocial Instruments. Reference lists were also searched. The COSMIN checklist was used to critically appraise these tools.
Results: 4622 studies were screened by title and abstract independently by two reviewers, 130 full text papers were obtained identifying 15 questionnaires. The majority were outdated and lacked adequate testing of reliability and validity. Only 2 questionnaires were specific for CP, and they assessed attitude & behavior rather than knowledge.
Conclusion: This paucity in valid questionnaires for assessing clinical knowledge of CP demonstrates a clear need for the development of a new valid questionnaire to assess knowledge among clinicians involved in CP management.

82. Perceived Impact of a Community-Based Task-Oriented Exercise Program Incorporating a Healthcare-Recreation Partnership among People with Neurological Conditions and Their Caregivers

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Background: The impact of community-based exercise programs incorporating a healthcare-recreation partnership (CBEP-HRP) in people with neurological conditions and their caregivers is not well understood.
Objectives: To explore the perceived impact of group, task-oriented CBEP-HRPs targeting balance and mobility on physical function, participation in meaningful activities, caregiver assistance and caregiver health among people with neurological conditions and their caregivers.
Methods: A descriptive qualitative study involving in-depth face-to-face or telephone interviews was conducted. Individuals with balance and mobility deficits from a neurological condition, with a caregiver, and registered in a group, task-oriented CBEP-HRP were included. Interviews were audio-recorded and transcribed verbatim, and reviewed for accuracy. Thematic analysis was performed.
Results: Nine people with stroke, four people with multiple sclerosis (n=13), and 12 caregivers (85% spouses) were interviewed. Two themes emerged, suggesting: (1) Exercise participants experienced interrelated improvements in strength, balance, mobility, ability to perform self-care/household activities and participation, that were reinforced with repeated program registration; and (2) caregivers experienced challenges associated with providing transportation, but realized benefits including reduced caregiver assistance and improved emotional health.
Conclusions: Findings suggest that community task-oriented exercise programs designed to improve balance and mobility have potential to improve the health of both exercise participants and caregivers.

83. Post-acute Care Pathways for Hip Fracture Patients: A System-level Analysis

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Background Guidelines suggest that rehabilitation after surgery for hip fracture patients is imperative to return patients to pre-morbid function. However, there is no evidence for in which setting this rehabilitation should occur. The *purpose* of this study is to describe regional variation in hip fracture patient characteristics and post-acute pathways within a health system. **Methods** Community-dwelling patients aged 66+ admitted to hospital for hip fracture between 2008-2013 were identified using administrative data. Post-acute pathways were characterized by linking patients' records using a unique encoded identifier and determining when each patient went to each post-acute destination. Differences between regions were detected using standardized differences and p-values. **Results** 36,029 hip fracture patients were included: 71.9% female with a mean age of 82.9 (± 7.5) and patient characteristics did not vary between regions. There was significant variation between health regions with respect to the immediate discharge destination: four regions discharged a substantially higher proportion of their patients to inpatient rehabilitation. However, patient characteristics between those four regions and all other regions did not significantly differ. **Conclusions** The notion that similar hip fracture patients are discharged to different post-acute settings in different regions raises questions about interregional standards and the efficacy of various post-acute pathways.

84. Project ECHO Ontario: You Are Not Alone in Managing Chronic Pain

H Sidrak1, L Carlin2, J Zhao1, R Fabico1, A Furlan1

1 Toronto Rehabilitation Institute; 2 University of Toronto, Department of Physical Therapy

Chronic pain is one of the most significant concerns of the health system with a reported prevalence in Canada of between 15% and 29% (Boulanger et al, 2007). Because management of chronic pain in pain clinics can be short term, increasing attention is being paid to the role of the primary care providers in interdisciplinary care (Gatchel et al, 2014). Project Extension for Community Healthcare Outcomes (ECHO), established in 2003 at the University of New Mexico, uses telemedicine to better manage chronic disease with proven outcomes in hepatitis C virus (Arora et al, 2011). Project ECHO Ontario uses weekly teleconferencing to educate primary care providers in best practices through didactics and case-based learning with longitudinal co-management of patients by primary care providers and specialists. The aim of this qualitative presentation is to outline the impact of participation in Project ECHO Ontario on primary care providers, using preliminary data collected through 3 focus group discussions in different locations in Ontario. Current analysis suggests that primary care providers benefit both from an increase in knowledge concerning chronic pain and finding a community facing similar challenges. We hypothesize that this may improve retention of primary care providers in under-resourced and remote parts of the province and may become a better way of leveraging scarce health resources in the practice of medicine.

85. Development of an Online Self-Management System for Bowel and Exercise Management after Spinal Cord Injury

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Online self-management programs typically address chronic conditions, like asthma or diabetes. While health management after spinal cord injury bears some resemblance to management of chronic conditions, persons with SCI report limited satisfaction with traditional self-management courses. We are therefore in the process of designing a self-management system for Canadians with SCI that is sensitive to the expressed needs of users. Our development paradigm is iterative and grounded in the philosophy of participatory design, which includes users at every stage of the process. A Consumer Advisory Group, made of persons with SCI from all over Canada, has been working with us to create requirements and provide feedback on iterations of system designs at regular intervals. Key features of the initial prototype include a library of diverse resources of potential relevance to bowel and exercise management as well as crowd-sourcing tools that encourage and allow management expertise residing in the user community to emerge. We will be presenting an initial design of our tool as an interactive display.

86. Circulating Biomarkers in Acute Myofascial Pain

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Objective: The aims of the present study were to compare levels of circulating inflammatory biomarkers and growth factors between patients with (myofascial pain syndrome) MPS and control participants as well as to assess the relationship among inflammatory markers and growth factors in the two groups.
Design: Patients (n=37) with myofascial pain complaints were recruited into the study from the hospital Emergency Department. Non-MPS control participants (n=21) were recruited via advertisements in the hospital and community.
Results: Blood levels of the cytokines IL-6, TNF and IL-12 and the chemokines MCP-1, MDC, eotaxin, GM-CSF, IL-8, MIP-1Î² were significantly higher in patients with MPS than controls. In contrast, significant differences were not found between groups in the macrophage inflammatory protein (MIP)-1Î±. The results of the growth factor analyses revealed significantly higher levels of FGF-2, PDGF, and VEGF in MPS patients versus controls. The pattern of correlation coefficients between cytokines and growth factors differed considerably for MPS patients and controls with far fewer significant coefficients observed in the controls. Serum inflammatory and growth factor biomarkers were elevated in MPS patients.
Conclusions: Inflammatory biomarkers and growth factor levels may play an important role in the onset and maintenance of MPS and therefore may be useful in the diagnosis and treatment of MPS. Understanding the mechanisms of inflammation in MPS necessitates future research.