Presented by

SUNNY HILL
HEALTH CENTRE FOR CHILDREN

SYLLABUS

THE 32nd INTERNATIONAL SEATING SYMPOSIUM

Imagine the Possibilities

March 1-4, 2016
The Westin Bayshore,
Vancouver, BC

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THE UNIVERSITY OF BRITISH COLUMBIA
Interprofessional Continuing Education

SUNNY HILL
HEALTH CENTRE FOR CHILDREN

PROGRAM-AT-A-GLANCE

WEDNESDAY | MARCH 2

08:00 Registration | Continental Breakfast, Exhibits & Posters
08:30 Opening Remarks
08:50 Keynote Address
09:35 Plenary
10:00 Plenary
10:25 Poster Presentations
10:40 Break | Refreshment & Exhibits
11:30 Instructional Session A
12:30 Lunch (provided) | Exhibits & Posters
14:00 Simultaneous Paper Sessions #1
15:15 Break | Refreshment & Exhibits
16:00 Instructional Session B
17:00 Welcome Reception & Exhibits

THURSDAY | MARCH 3

08:00 Registration | Continental Breakfast, Exhibits & Posters
08:30 Opening Remarks
08:40 Plenary
09:05 Plenary
09:30 Break | Refreshment & Exhibits
10:20 Simultaneous Paper Sessions #2
11:35 Lunch (provided) | Exhibits
12:00 Poster Session
13:00 Instructional Session C
14:10 Instructional Session D
15:10 Break | Refreshment & Exhibits
16:00 Plenary Panel
17:00 Adjourn

FRIDAY | MARCH 4

08:00 Registration | Continental Breakfast & Posters
08:30 Instructional Session E
09:40 Instructional Session F
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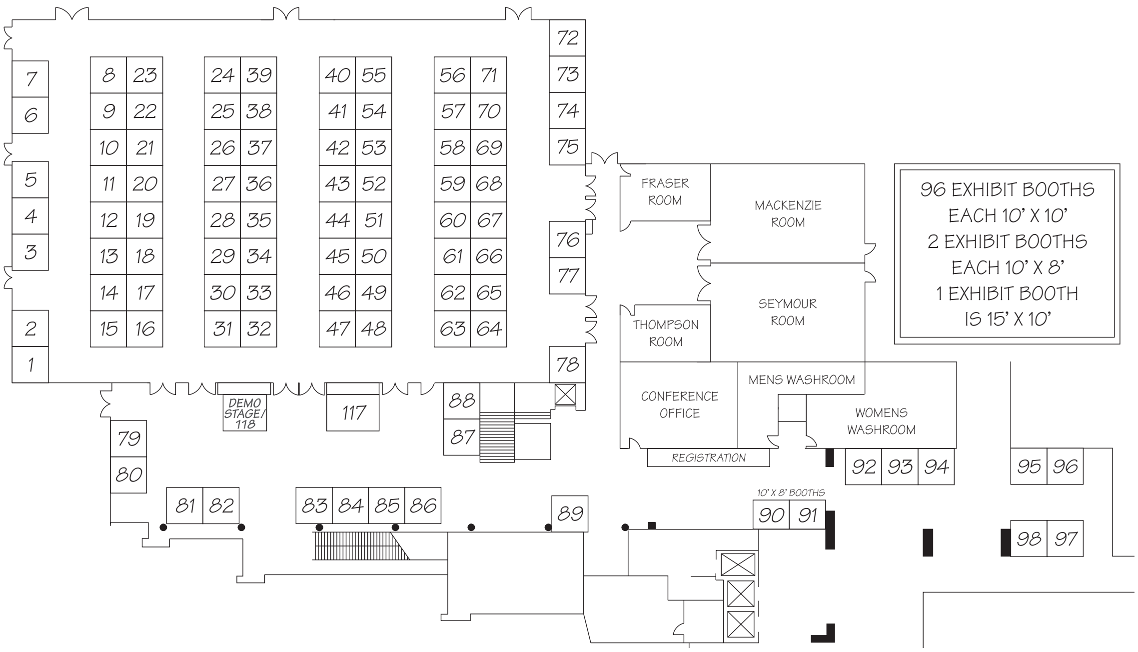
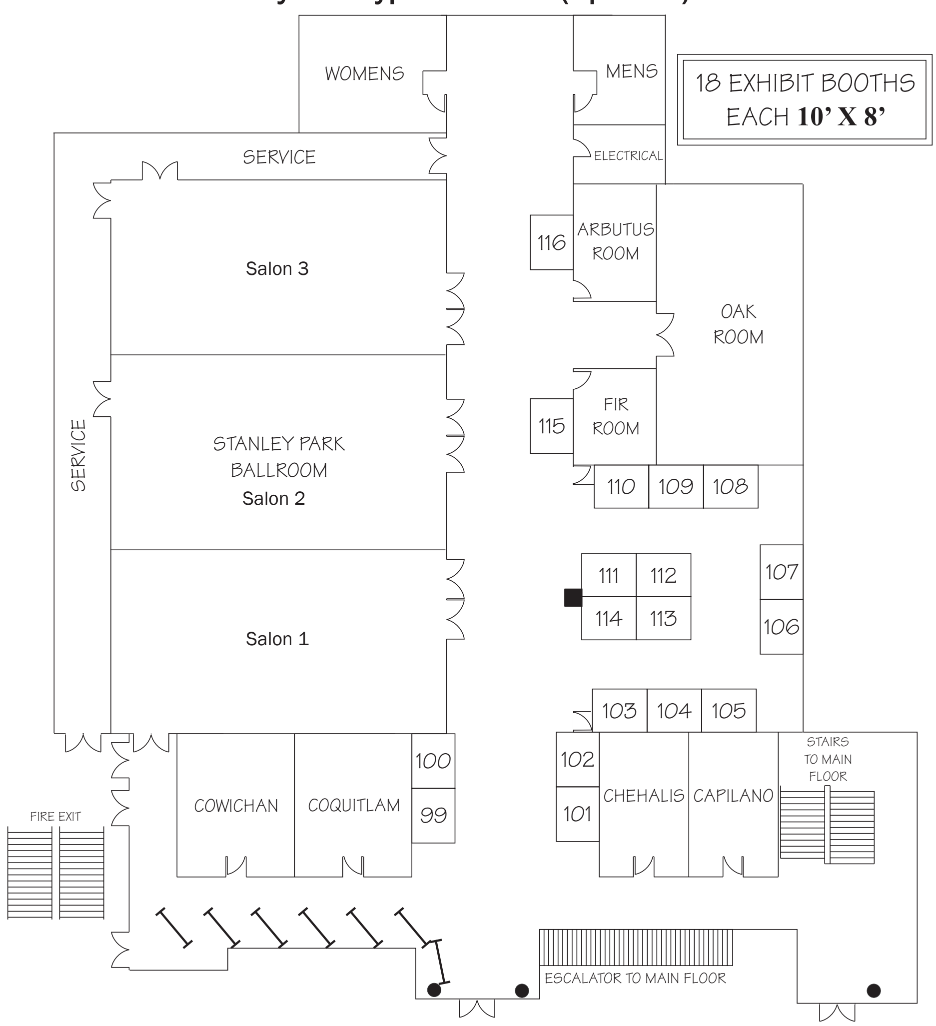
Exhibitor Booth Layout

Bayshore Ballroom & Foyer (Downstairs)



Foyer & Cypress Room (Upstairs)



Speaker Listing

A

Marlene Adams, BHSc, Occupational Therapist, UHN, Toronto Rehab Institute
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"From Paper to Practice: Clinical Application of Evidence-Based Practice in Seating and Mobility"
F1, Friday, March 4, 2016, 09:40 - 10:40

Tim Adlam, PhD CEng, Head of Mechanical Engineering, Designability Wolfson Centre
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"Designing for Dystonia: Begin at the Beginning with Children, Parents and Therapists"
Paper Session #1, Salon 1v, Wednesday, March 2, 2016, 15:00 - 15:15
"Paediatric Power Mobility- Increasing Options for Early Independent Mobility"
PS4, Tuesday, March 1, 2016, 09:00 - 12:15

Malene Ahern, B. Sc.(Physiotherapy Hons 1), National Clinical Manager, Permobil Australia
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"Utilising Bio-Mechanical Principles in Conjunction with Complex Modular Seating Solutions to Continuously Support the Changing Posture and Function of a Wheelchair User"
B2, Wednesday, March 2, 2016, 16:00 - 17:00

Lindsay Alford, BSc OT, Occupational Therapist, Access Community Therapists
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"The Art of Balance: Function and Posture in Wheelchair Seating"
C3, Thursday, March 3, 2016, 13:00 - 14:10

Ana Allegretti, PhD, ATP, OTR, Assistant Professor/ Occupational Therapist, University of Texas Health Sciences
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"Driving Controls for a Patient with ALS- A Clinical Case"
Poster

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"Seating the Client with Complex Needs"
PS3, Tuesday, March 1, 2016, 09:00 - 16:30

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"The CanWheel Power Wheelchair Outcomes Toolkit: Overview and Application"
E2, Friday, March 4, 2016, 08:30 - 09:30

B

Joel Bach, PhD, Associate Professor, Colorado School of Mines
1610 Illinois St.
Golden, CO, 80401
jmbach@mines.edu
"Using Biomechanical Principles in the Management of Complex Postural Deviations in Sitting"
PS1, Tuesday, March 1, 2016, 09:00 - 16:30

Rae Baines, BSc Occupational Therapy, Postgrad Certificate in Education, Children's Occupational Therapist, Designability Wolfson Centre Department D1
Bath, UK, BA1 3NG
raebaines@designability.org.uk
"Paediatric Power Mobility- Increasing Options for Early Independent Mobility"
PS4, Tuesday, March 1, 2016, 09:00 - 12:15

Erin Baker, DPT, PT, DPT, ATP, Nemours Children's Hospital
13535 Nemours Parkway
Orlando, FL, 32827
erin.baker@nemours.org
"Conquering the Complexity of Writing a Letter of Medical Necessity"
B4, Wednesday, March 2, 2016, 16:00 - 17:00

Elizabeth G Ball, Physiotherapist, Private Therapist
3206 West 5th Ave
Vancouver, BC, V6K 1V4
michelleharveyot@gmail.com
"Ceiling Lifts, Slings, wheelchairs and Seating-The Connection!"
PS6, Tuesday, March 1, 2016, 13:15 - 16:30

Theresa F. Berner, MOT, Occupational Therapy, The Ohio State University Wexner Medical Center
2050 Kenny Road, MMMP-Pavilion, Suite 3350
Columbus, OH, 43221
theresa.berner@osumc.edu
"The Clinician Scientist in the Seating and Mobility Clinic: A Foundation for Education, Research and Clinical Practice"
E5, Friday, March 4, 2016, 08:30 - 09:30

Krista L. Best, MSc, Phd, Postdoctoral Fellow, Center for Interdisciplinary Research in Rehabilitation and Social Integration (CIRRIS), Université Laval
525 blvd Hamel, Québec, QC, G1M 2S8
krista-lynn.best.1@ulaval.ca
"Feasibility of a Peer-led, Self-Efficacy Enhanced Wheelchair Training Program for Older Adults: Study Protocol of a Randomized Controlled Trial"
Paper Session #2, Salon 3iii, Thursday, March 3, 2016, 10:50 - 11:05

Jennifer Birt, BMR OT, Occupational Therapist, Winnipeg Health Sciences
Winnipeg, MB
JLBirt@exchange.hsc.mb.ca
"Applying Current Evidence to Clinical Practice for Pressure Management in Wheelchairs and Seating"
PS5, Tuesday, March 1, 2016, 09:00 - 12:15

Sheila Blochlinger, PT, PT, ATP, Children's Specialized Hospital
3575 Quaker Bridge Road
Hamilton Township, NJ, 08619
sblochli3@gmail.com
"Laying the Foundation of Wheelchair Seating and Mobility Assessments"
PS2, Tuesday, March 1, 2016, 09:00 - 16:30

Lois Brown, MPT, Physical Therapist/Seating and Mobilty Specialist, Dynamic Home Therapy
275 S. Bryn Mawr Ave, Apt C-03
Bryn Mawr, PA, 19010
Brownlois12@gmail.com
""A Day in the Life" At Home Complex Rehab Equipment Evaluations: An Individualized Process"
D5, Thursday, March 3, 2016, 14:10 - 15:10

C

Rosaria Eugenia Caforio, Managing Director, Designer, Pro Medicare Srl
Via Montagna, Mesagne, Br, Italy, 72023
rcaforio@promedicare.it
"Different Seats Impact on Spinal Cord Injury (Sci) Subjects and Effectiveness of Pelvic Total Support: A Multicentric Study"
Paper Session #2, Salon 2i, Thursday, March 3, 2016, 10:20 - 10:35

Nicole Captain, M.Sc. OT, OT Reg(Ont), Occupational Therapist, Holland Bloorview Kids Rehabilitation Hospital
Toronto, ON
ncaptain@hollandbloorview.ca
"The Paediatric Positioning Puzzle: Balancing Support with Function"
C5, Thursday, March 3, 2016, 13:00 - 14:10

Timothy Caruso, PT, MBA, MS, Shriners Hospital for Children Chicago Unit
2211 N Oak Park Ave
Chicago, IL, 60707
tcaruso@shrinenet.org
"Power Wheelchair Mobility Training for Young Children"
Paper Session #1, Salon 1i, Wednesday, March 2, 2016, 14:00 - 14:15

Victor Carvente, 3D Printing Specialist, CUSHMAKER.com
14535 Valley View Avenue, Suite U
Santa Fe Springs, CA, 90670
vic.cushmaker@gmail.com
"Spot-On, Hands-Free and On-Demand Manufacturing -The Implications of 3D Printing for Seating, Positioning & Mobility Services"
F2, Friday, March 4, 2016, 09:40 - 10:40

Krista Carwana, Occupational Therapist, Access Community Therapists Ltd.
1534 Rand Avenue
Vancouver, BC, V6P 3G2
krista@accesstherapists.com
"Seating the Client with Complex Needs"
PS3, Tuesday, March 1, 2016, 09:00 - 16:30

Jo-Anne Chisholm, MSc, Occupational Therapist, Access Community Therapists Ltd.
1534 Rand Avenue
Vancouver, BC, V6P 3G2
joanne@accesstherapists.com
"Seating the Client with Complex Needs"
PS3, Tuesday, March 1, 2016, 09:00 - 16:30
"Seating for Pressure Management"
E4, Friday, March 4, 2016, 08:30 - 09:30

Elizabeth Cole, MSPT, ATP, Director of Clinical Applications, ROHO, Inc
6 Colony Brook Lane
Belleville, IL, 3038
ewcole828@gmail.com
"What's New in Medicare Reimbursement?"
D4, Thursday, March 3, 2016, 14:10 - 15:10

David Cooper, (Co-Chair) MSc (Kinesiology), Rehabilitation Technologist, Therapy Department, Sunny Hill Health Centre for Children
Vancouver, BC
dcooper@cw.bc.ca
Opening Remarks, Wednesday, March 2, 2016, 08:30 - 08:50

Barbara Crane, PhD, PT, ATP/SMS, Professor, PT, University of Hartford
200 Bloomfield Ave
West Hartford, CT, 06117
bcrane@hartford.edu
"Clinical Application of the Dispersion Index"
A6, Wednesday, March 2, 2016, 11:30 - 12:30

D

Brad Dicianno, MD, Attending Physician, Medical Director, Human Engineering Research Laboratories
6425 Penn Ave, Suite 400
Bakery Square, PA, 15206
dicibe@UPMC.EDU
"Seat Elevators: How to Utilize the Functional Mobility Assessment to Track Function and Justify Medical Necessity"
Paper Session #2, Salon 1iv, Thursday, March 3, 2016, 11:05 - 11:20

Carmen P. DiGiovine, PhD, Associate Professor, The Ohio State University
406 Atwell Hall, 453 W. 10th Ave
Columbus, OH, 43035
digiovine.1@osu.edu
"Whole Body Vibration Measurement System for Power Wheelchairs"
Paper Session #2, Salon 2v, Thursday, March 3, 2016, 11:20 - 11:35
"Shoulder Evaluation and Intervention for Manual Wheelchair Users"
D3, Thursday, March 3, 2016, 14:10 - 15:10
"The Clinician Scientist in the Seating and Mobility Clinic: A Foundation for Education, Research and Clinical Practice"
E5, Friday, March 4, 2016, 08:30 - 09:30

Janice Duivestein, Occupational and Physical Therapist, Sunny Hill Health Centre for Children and Access Community Therapists Ltd
3644 Slocan Street
Vancouver, BC, V5M 3E8
duivests@telus.net
"Seating the Client with Complex Needs"
PS3, Tuesday, March 1, 2016, 09:00 - 16:30

Trevor A Dyson-Hudson, MD, Director, Kessler Foundation
1199 Pleasant Valley Way
West Orange, NJ, 07052
tdysonhudson@KesslerFoundation.org
"You Got To Move It, Move It! Pressure Relief Behaviors and Weight Shifting Activities to Prevent Pressure Ulcers in Persons with SCI"
C6, Thursday, March 3, 2016, 13:00 - 14:10

E

Andrew Edwards, Director, V-TRAK
Kent Road
Bridgend, Wales, UK, CF31 3TU
Andrew@v-trak.com
"Utilising Bio-Mechanical Principles in Conjunction with Complex Modular Seating Solutions to Continuously Support the Changing Posture and Function of a Wheelchair User"
B2, Wednesday, March 2, 2016, 16:00 - 17:00

Janice Evans, Physiotherapist, Sunny Hill Health Centre For Children
3644 Slocan Street
Vancouver, BC, V5M 3E8
jevans@cw.bc.ca
"Seating the Client with Complex Needs"
PS3, Tuesday, March 1, 2016, 09:00 - 16:30

F

Susan E Farricielli, MID, Industrial Designer, Managing Partner, Kinetic Innovative Seating System
26 N. Main St., Office Bldg. 2nd Floor
Branford, CT, 6405
susan@kissforwheelchairs.com
"Product Design Innovation"
A1, Wednesday, March 2, 2016, 11:30 - 12:30

John P Farris, PhD, Engineer, Grand Valley State University
223 John C Kennedy Hall of Engineering
Grand Rapids, MI, 40503
farrisj@gvsu.edu
"Em-POWERment: Power Mobility Training Methods for Children and Adolescents with Multiple Severe Disabilities"
C1, Thursday, March 3, 2016, 13:00 - 14:10
"Use of Electroencephalography to Objectively Assess Power Mobility Use in Children with Severe Disabilities: A Pilot Project"
Poster
"Power Mobility Training For Young Children with Multiple, Severe Disabilities: A Case Series"
Poster

Debra A Field, BScOT, MHSc OT, Occupational Therapist, Sunny Hill Health Centre for Children
3644 Slocan St
Vancouver, BC, V2R 5H4
dfield@cw.bc.ca
"Paediatric Power Mobility- Increasing Options for Early Independent Mobility"
PS4, Tuesday, March 1, 2016, 09:00 - 12:15
"Measuring Participation in Daily Life for Children and Youth Using Power Mobility"
Paper Session #1, Salon 1iii, Wednesday, March 2, 2016, 14:30 - 14:45
"Sit-To-Stand Wheelchairs and Their Use by Children and Youth with Mobility Limitations: A Case Series"
Paper Session #1, Salon 1iv, Wednesday, March 2, 2016, 14:45 - 15:00
"The Wheelchair Outcome Measure for Young People: On-Going Development and Clinical Usefulness"
Poster

Kathryn Fisher, B.Sc.(OT), Clinical Educator/Rehab Technology Consultant, Shoppers Home Health Care
104 Bartley Dr
Toronto, ON, M4A 1C5
kfisher@shoppershomehealthcare.ca
"The Paediatric Positioning Puzzle: Balancing Support with Function"
C5, Thursday, March 3, 2016, 13:00 - 14:10

Jane Fontein, BHSc.OT, Clinical Educator, Motion Composites and Dynamic Health Care Solutions
519 Rue J. Oswald Forest Unit#101
St. Roch-de-l'Achigan, QC, J0K3H0
janefontein@gmail.com
"When Wheelchairs Won't Roll: Top 10 Maintenance Tips for Perfect Manual Wheelchair Performance"
PS7, Tuesday, March 1, 2016, 13:15 - 16:30

Delia Freney, OTR/L ATP, Kaiser
19356 Darcrest Court
Castro Valley, CA, 94545
ddfreney@aol.com
"Global RePurposing: A Model for Meeting the Needs of the Underserved Internationally"
Poster

G

Rachel Gartz Student, University of Pittsburgh
reg41@pitt.edu
"How to Develop a Contextually Appropriate, Reliable, and Valid Wheelchair Service Provision Assessment"
A3, Wednesday, March 2, 2016, 11:30 - 12:30

Ed Giesbrecht, M.Sc., BMR(OT), Assistant Professor, University of Manitoba
R106 - 771 McDermot Avenue
Winnipeg, MB, R3E0T6
ed.giesbrecht@umanitoba.ca
"Get In the Game: Gaming Technology for Wheelchair Skills Training"
Paper Session #2, Salon 3ii, Thursday, March 3, 2016, 10:35 - 10:50

Mary Goldberg, PhD, Assistant Professor, International Society of Wheelchair Professionals (ISWP)
6246 Penn Ave. Suite 400
Pittsburgh, PA, 15206
mrh35@pitt.edu
"How to Develop a Contextually Appropriate, Reliable, and Valid Wheelchair Service Provision Assessment"
A3, Wednesday, March 2, 2016, 11:30 - 12:30

H

Michelle Brigid Harvey, B.Sc. Hons OT, OT / Mobility Consultant
Vancouver, BC,
michelleharveyot@gmail.com
"Ceiling Lifts, Slings, wheelchairs and Seating-The Connection!"
PS6, Tuesday, March 1, 2016, 13:15 - 16:30

Tatsuo Hatta, PhD, Professor/Occupational Therapist, Hokkaido University
North 12, West 5, Kita-ku
Sapporo, Hokkaido, Japan, 060-0812
thatta@hs.hokudai.ac.jp
"New Wheelchair Accessory Prevents a Hunched Forward Head Posture While Seated"
Poster

Tom Hetzel, PT, ATP, CEO, Ride Designs
4211-G South Natches Court
Sheridan, CO, 80110
tom@ridedesigns.com
"Clinical Application of the Dispersion Index"
A6, Wednesday, March 2, 2016, 11:30 - 12:30

Corey W. Hickey, DO, Resident Physician, Academic Chief Resident, University of Pittsburgh
3471 Fifth Avenue, Kaufmann Medical Building, Suite 201
Pittsburgh, PA, 15213
hickeycw@upmc.edu
"Seat Elevators: How to Utilize the Functional Mobility Assessment to Track Function and Justify Medical Necessity"
Paper Session #2, Salon 1iv, Thursday, March 3, 2016, 11:05 - 11:20

Marlene Holder, B.Sc.,P.T., Physiotherapist, Marlene Holder Physiotherapy
13 Walter St
Toronto, ON, M4E 2Y9
marleneholderpt@gmail.com
"Aging with Cerebral Palsy"
C4, Thursday, March 3, 2016, 13:00 - 14:10

Cheryl Hon, M. OT, Occupational Therapist, Access Community Therapists
1534 Rand Avenue
Vancouver, BC, V6P 3G2
cheryl@accesstherapists.com
"The Art of Balance: Function and Posture in Wheelchair Seating"
C3, Thursday, March 3, 2016, 13:00 - 14:10

K

Ellen Kaandorp, Occupational Therapist, Coordinator Seating Team, Heliomare Rehabilitation Centre
Relweg 51
Wijk aan Zee, The Netherlands, 1949EC
E.kaandorp@heliomare.nl
"A Seating Advisory Team in the Netherlands"
Paper Session #1, Salon 3iv, Wednesday, March 2, 2016, 14:45 - 15:00

Tadahiko Kamegaya, PhD, Occupational Therapist, Gunma University Graduate School Of Health Sciences
39-22, Showa-Machi 3-Chome
Maebashi, Gunma, Japan, 371-8514
kamelab@gunma-u.ac.jp
"Influence Of Sacral Sitting In A Wheelchair On The Contact Pressure Distributions On The Buttocks And Back And Shear Force On The Ischial Area Of Wheelchair Users"
Paper Session #2, Salon 2ii, Thursday, March 3, 2016, 10:35 - 10:50
"Influences of Sacral Sitting on the Manual Wheelchair Propulsion Ability"
Poster

Karen M Kangas, B.Sc of OT, Occupational Therapist, Karen M. Kangas OTR/L (private practice)
1 Beaver Road
Camp Hill, PA, 17011
kmkangas@ptd.net
"Common Problems in Seating and Access to integration and use of Assistive Technology"
F4, Friday, March 4, 2016, 09:40 - 10:40

Lisa K. Kenyon, PhD, Associate Professor, Grand Valley State University
301 Michigan St. NE, Suite 247
Grand Rapids, MI, 49503-3314
kenyonli@gvsu.edu
"Smart Wheelchairs in Assessment and Training: Findings from a Consensus Workshop"
Paper Session #2, Salon 3v, Thursday, March 3, 2016, 11:20 - 11:35
"Em-POWERment: Power Mobility Training Methods for Children and Adolescents with Multiple Severe Disabilities"
C1, Thursday, March 3, 2016, 13:00 - 14:10
"Use of Electroencephalography to Objectively Assess Power Mobility Use in Children with Severe Disabilities: A Pilot Project"
Poster
"Power Mobility Training For Young Children with Multiple, Severe Disabilities: A Case Series"
Poster

R. Lee Kirby, MD, FRCPC, Dalhousie University - Nova Scotia Rehabilitation Centre
1341 Summer Street
Halifax, NS, B3H 3E2
kirby@dal.ca
"Using the Wheelchair Skills Test (WST) and Wheelchair Skills Test Questionnaire (WST-Q) to Assess Manual and Powered Wheelchair Users – A Practical Workshop"
A4, Wednesday, March 2, 2016, 11:30 - 12:30
"CanWheel: Improving Power Wheeled Mobility for Older Canadians"
B5, Wednesday, March 2, 2016, 16:00 - 17:00
"*Wheelchair Skills Assessment and Training – What in the World is Going On!?"*
Plenary, Thursday, March 3, 2016, 09:05 - 09:30
"The CanWheel Power Wheelchair Outcomes Toolkit: Overview and Application"
E2, Friday, March 4, 2016, 08:30 - 09:30

Kay Koch, OTR/L, ATP RESNA Fellow, Occupational Therapist, 296 Hascall Road NW
Atlanta, GA, 30309
kkotrchoa@yahoo.com
"Arthrogryposis -Challenges & Solutions When A Non Progressive Diagnosis Progresses"
B1, Wednesday, March 2, 2016, 16:00 - 17:00

Wendy M Koesters, B.Sc., Physical Therapist, ATP/SMS, Ohio State Wexner Medical Center
2050 Kenny Rd. Suite 3300
Columbus, OH, 43221-3502
wendy.koesters@osumc.edu
"Shoulder Evaluation and Intervention for Manual Wheelchair Users"
D3, Thursday, March 3, 2016, 14:10 - 15:10

Kara Kopplin, Senior Director, ROHO Inc
Belleville, IL
Kara.Kopplin@permobil.com
"Air-Cell-Based Cushions Protect Seated Bariatric/Diabetic Patients: Computer Simulation Studies"
Paper Session #1, Salon 3ii, Wednesday, March 2, 2016, 14:15 - 1430

Ken Kozole, BSME, OTR/L, ATP, Occupational Therapist, Shriners Hospital for Children
Fairfax Rd @ Virginia St
Salt Lake City, UT, 84103
kkozole@shrinenet.org
"Tune Up Time: Optimizing Function and Performance"
D1, Thursday, March 3, 2016, 14:10 - 15:10
"Off the shelf and out of the box: Adaptation of commercially available product to meet custom needs"
Poster

L

Michelle L Lange, Occupational Therapist, Access to Independence
11785 W. 56th Drive
Arvada, CA, 80002
MichelleLange@msn.com
"Power Wheelchair Driving Methods for People with Muscle Weakness"
A5, Wednesday, March 2, 2016, 11:30 - 12:30

Scott Langmead, Bac Sc (OT), Senior Occupational Therapist, Ability Centre Australasia
106 Bradford St
Coolbinia, Western Australia, Australia, 6929
scott.langmead@abilitycentre.com.au
"Paediatric Power Mobility- Increasing Options for Early Independent Mobility"
PS4, Tuesday, March 1, 2016, 09:00 - 12:15
"My First Wheels: An Evaluation of a Novel Powered Mobility Device for Use in Early Intervention"
D2, Thursday, March 3, 2016, 14:10 - 15:10

Roslyn W Livingstone, MSc(RS), Occupational Therapist, Sunny Hill Health Centre for Children
3644 Slocan St
Vancouver, BC, V2R 5H4
rlivingstone@cw.bc.ca
"Paediatric Power Mobility- Increasing Options for Early Independent Mobility"
PS4, Tuesday, March 1, 2016, 09:00 - 12:15
"Sit-To-Stand Wheelchairs and Their Use by Children and Youth with Mobility Limitations: A Case Series"
Paper Session #1, Salon 1iv, Wednesday, March 2, 2016, 14:45 - 15:00
"Gait Trainers: Evidence-Based Clinical Practice Guidelines"
E3, Friday, March 4, 2016, 08:30 - 09:30

Matt Lowell, MPT, Physical Therapist, Shriners Hospital for Children
Fairfax Rd @ Virginia St
Salt Lake City, UT, 84103
mlowell@shrinenet.org
"Tune Up Time: Optimizing Function and Performance"
D1, Thursday, March 3, 2016, 14:10 - 15:10
"Off the shelf and out of the box: Adaptation of commercially available product to meet custom needs"
Poster

M

Dianna Mah-Jones, BScOT, MSA, Occupational Therapist, Vancouver Coastal Health, G.F. Strong Rehab Centre
4255 Laurel St.
Vancouver, BC, V5Z 2G9
Dianna.Mah-Jones@vch.ca
"An External Support Device for a Liver and Kidney Prolapse"
Poster

Johanne L Mattie, MASc, Project Lead, British Columbia Institute of Technology
3700 Willingdon
Burnaby, BC, V5G 3H2
johanne_mattie@bcit.ca
"Development and Evaluation of an Ultralight Wheelchair with On-The-Fly Adjustability of Rear Seat Height, Backrest Angle, and A "Kneeling" Function"
Poster

Mary McDonagh, Senior Physiotherapist/ Co-ordinator of Training and Development, Central Remedial Clinic
Vernon Avenue,
Clontarf Dublin 3, Ireland
mmcdonagh@crc.ie
"Specialized Seating and Mobility: Meeting goals and managing expectations"
F6, Friday, March 4, 2016, 09:40 - 10:40

Linda McGowan, BScN, MBA, Ambassador MS Society, Author Travelling the World with MS In a Wheelchair
1401-1250 Quayside Drive
New Westminster, BC, V3M 6E2
lin@shaw.ca
"Creative Accessibility and Motivation to Embrace Our Dreams"
Keynote, Wednesday, March 2, 2016, 08:50 - 09:35

Lynore McLean, PT, Physiotherapist, Sunny Hill Health Centre for Children
3644 Slocan Street
Vancouver, BC, V5M 3E8
lmclean3@cw.bc.ca
"Heat Dissipation in a Custom Molded Seating System"
Paper Session #2, Salon 2iv, Thursday, March 3, 2016, 11:05 - 11:20

Sandra A Metzler, DSc, PE, Associate Professor, The Ohio State University
W296N Scott Lab, 201 W 19th Ave
Columbus, OH, 43210
metzler.136@osu.edu
“Whole Body Vibration Measurement System for Power Wheelchairs”
Paper Session #2, Salon 2v, Thursday, March 3, 2016, 11:20 - 11:35

Alexandria Miles, MS, CRC, PhD Student, University of Pittsburgh
Pittsburgh, PA
amm403@pitt.edu
“How to Develop a Contextually Appropriate, Reliable, and Valid Wheelchair Service Provision Assessment”
A3, Wednesday, March 2, 2016, 11:30 - 12:30

William Miller, Principal Investigator, Rehab Research Lab
4255 Laurel St
Vancouver, BC, V5Z2G9
bill.miller@ubc.ca
“CanWheel: Improving Power Wheeled Mobility for Older Canadians”
B5, Wednesday, March 2, 2016, 16:00 - 17:00
“Get In the Game: Gaming Technology for Wheelchair Skills Training”
Paper Session #2, Salon 3ii, Thursday, March 3, 2016, 10:35 - 10:50
“The CanWheel Power Wheelchair Outcomes Toolkit: Overview and Application”
E2, Friday, March 4, 2016, 08:30 - 09:30

Yuji Minami, OTR, Takenotsuka Noushinkei Rehabilitation Hospital
4-15-16 Hokima, Adachi-ku
Tokyo, Japan, 121-0064
nqk20339@nifty.com
“Relationship between Pelvic Tilt Angles and Seat Pressure Distribution with Different Cushion Types”
Poster

Jean L Minkel, PT, ATP, Senior Vice President, Independence Care System
25 Elm Place, 5th Floor
Brooklyn, NY, 11201
jminkel@aol.com
“What Matters Most - Hosting Difficult Conversations”
Plenary, Thursday, March 3, 2016, 08:40 - 09:05
“Progressive Conditions: The Personal Journey”
Plenary Panel, Thursday, March 3, 2016, 16:00 - 17:00

Ian M Mitchell, PhD, BASc, MSc, Associate Professor, University of British Columbia
2366 Main Mall
Vancouver, BC, V6T 1Z4
mitchell@cs.ubc.ca
“Smart Wheelchairs: Why they are (and why they aren’t) almost here”
Plenary, Wednesday, March 2, 2016, 10:00 - 10:25

Shelley RH Mockler, PT, DSc, Physical Therapist, Center for Disabilities and Development
100 Hawkins Drive
Iowa City, IA, 52242
shelley-mockler@uiowa.edu
“Predictors of Proficient Power Mobility in Young Children with Severe Motor Impairments”
Paper Session #1, Salon 1ii, Wednesday, March 2, 2016, 14:15 - 14:30

Ben Mortenson, PhD, Assistant Professor, University of British Columbia
T325 2211 Wesbrook Mall
Vancouver, BC, V6T2B5
ben.mortenson@ubc.ca
“Training Considerations in Using a SmartDrive”
Paper Session #1, Salon 2iv, Wednesday, March 2, 2016, 14:45 - 15:00
“CanWheel: Improving Power Wheeled Mobility for Older Canadians”
B5, Wednesday, March 2, 2016, 16:00 - 17:00
“The Biomechanics of Using the SmartDrive for Wheelchair Propulsion”
Paper Session #2, Salon 1v, Thursday, March 3, 2016, 11:20 - 11:35
“Measurement Properties of the Wheelchair Skills Test for Scooters”
Paper Session #2, Salon 3i, Thursday, March 3, 2016, 10:20 - 10:35
“The CanWheel Power Wheelchair Outcomes Toolkit: Overview and Application”
E2, Friday, March 4, 2016, 08:30 - 09:30

N

Linda Norton, B.Sc.OT, MScCH, Manager, Learning and Development, Shoppers Home Health Care
243 Consumers Road, 14th Floor
New York, ON, M2J 4W8
lnorton@shoppershomehealthcare.ca
"Ethically Prescribed Technology"
Plenary, Friday, March 4, 2016, 11:25 - 11:50

O

Koji Oka, OTR, Aijinkai Rehabilitation Hospital
Hakubai cho 5-7
Takatuki city, Osaka, Japan, 569-1116
"A New Trial of All Rental Wheel Chairs and Walking Aid Devices in Kaihukuki(Suacute)Rehabilitation Hospital"
Paper Session #2, Salon 1i, Thursday, March 3, 2016, 10:20 - 10:35

P

Ginny S Paleg, DScPT, Physical Therapist, Montgomery County Infant & Toddler Services
420 Hillmoor Drive
Silver Spring, MD, 20901
ginny@paleg.com
"Paediatric Power Mobility- Increasing Options for Early Independent Mobility"
PS4, Tuesday, March 1, 2016, 09:00 - 12:15
"Gait Trainers: Evidence-Based Clinical Practice Guidelines"
E3, Friday, March 4, 2016, 08:30 - 09:30

Richard Pasillas, Complex Seating Specialist, CUSHMAKER
14535 Valley View Avenue, Suite U
Santa Fe Springs, CA, 90670
Cushmasterrick@gmail.com
"Spot-On, Hands-Free and On-Demand Manufacturing -The Implications of 3D Printing for Seating, Positioning & Mobility Services"
F2, Friday, March 4, 2016, 09:40 - 10:40

Shaun Pathmanatan, Technical Support Specialist, Motion Composites
519 Rue J. Oswald Forest Unit #101
St. Roch-de-l'Achigan, QC, J0K3H0
shaun@motioncomposites.com
"When Wheelchairs Won't Roll: Top 10 Maintenance Tips for Perfect Manual Wheelchair Performance"
PS7, Tuesday, March 1, 2016, 13:15 - 16:30

Mark J Payette, CO, ATP, Manager of Clinical Service Development and Education, Tamarack Habilitation Technologies Inc.
1670 94th Lane NE
Minneapolis, MN, 55449
markp@tamarackhti.com
"A New Approach to Pressure, Friction, Shear and Microclimate Management in Wheelchair Seating - Imagine the Possibilities"
Paper Session #2, Salon 2iii, Thursday, March 3, 2016, 10:50 - 11:05
"Garments for Friction Management for Wheelchair or Extended Bed Surface Users"
Poster

Jon Pearlman, PhD, Assistant Professor, International Society of Wheelchair Professionals (ISWP)
6246 Penn Ave.
Pittsburgh, PA, 15206
jlp46@pitt.edu
"How to Develop a Contextually Appropriate, Reliable, and Valid Wheelchair Service Provision Assessment"
A3, Wednesday, March 2, 2016, 11:30 - 12:30

Jessica Presperin Pedersen, OTR/L, MBA, ATP/SMS, OT Research PI, Rehabilitation Institute of Chicago- Center for Rehabilitation Outcomes Research
345 E. Superior St.
Chicago, IL, 60611
jjpedersen@comcast.net
"Does Wheelchair Configuration Make a Difference In Wheelchair Skills?"
Paper Session #1, Salon 2ii, Wednesday, March 2, 2016, 14:15 - 14:30
"I'm Leaving on a Jet Plane. I Hope I'll See My Chair Again"
Plenary, Friday, March 4, 2016, 11:00 - 11:25
"Boarding Devices and Aircraft Seats- Increasing Safety, Support, and Comfort"
Poster

Ean Price, ICAN Resource Group
Kelowna, BC
ean@icanresourcegroup.com
"Progressive Conditions: The Personal Journey",
Plenary Panel, Thursday, March 3, 2016, 16:00 - 17:00

Q

Carla Qualtrough, Minister of Sport and Person with Disabilities
Opening Remarks, Wednesday, March 2, 2016, 08:30 - 08:50

R

Ian Rice, PhD,MS OT, Assistant Professor, University of Illinois at Urbana Champaign
Champaign, IL
ianrice@illinois.edu
"Impact of Transfer Training Among Full Time Pediatric Wheelchair Users"
Paper Session #1, Salon 2i, Wednesday, March 2, 2016, 14:00-14:15

Karen Rispin, M.Sc, Associate Professor of Biology, LeTourneau University
2100 South Mobberly Ave
Longview, TX, 75602
karenrispin@letu.edu
"Reliability and Sensitivity of the Wheelchair Components Questionnaire for Condition"
Paper Session #2, Salon 1ii, Thursday, March 3, 2016, 10:35 - 10:50

Guy Robert, B.SC., Occupational Therapist
6300, Avenue Darlington
Montréal, QC, H3S 2J4
guy.robert.irglm@ssss.gouv.qc.ca
"Impacts of Different Types of Wheelchair Backrests on the Propulsion Performance on Manual Wheelchair Propulsion: An Exploratory Study"
Paper Session #1, Salon 2iii, Wednesday, March 2, 2016, 14:30 - 14:45

Tina Roesler, PT, MS, ABDA, International Business Development, Motion Composites
8018 Revenna Lane
Springfield, VA, 22153
t.roesler@motioncomposites.com
"When Wheelchairs Won't Roll: Top 10 Maintenance Tips for Perfect Manual Wheelchair Performance"
PS7, Tuesday, March 1, 2016, 13:15 - 16:30
"The Clinician Scientist in the Seating and Mobility Clinic: A Foundation for Education, Research and Clinical Practice"
E5, Friday, March 4, 2016, 08:30 - 09:30

Lisa M Rotelli, PT, Director, Adaptive Switch Labs, Inc
125 Spur 191, Suite C
Spicewood, TX, 78669
lrotelli@asl-inc.com
"Common Problems in Seating and Access to integration and use of Assistive Technology"
F4, Friday, March 4, 2016, 09:40 - 10:40

François Routhier, PhD, PEng, Centre For Interdisciplinary Research In Rehabilitation and Social Integration
525 Wilfrid-Hamel Est, Room 1116
Quebec City, QC, G1M 2S8
Francois.Routhier@rea.ulaval.ca
"Manual Wheelchair Data Logging: Outcomes, Challenges and Barriers"
Paper Session #2, Salon 1iii, Thursday, March 3, 2016, 10:50 - 11:05

Paula Rushton, Assistant Professor, Université de Montréal École de réadaptation - Centre de Réadaptation Marie Enfant - CHU Sainte-Justine, 5200, rue Bélanger Est
Montréal, QC, H1T1C9
pwrushton@gmail.com
"CanWheel: Improving Power Wheeled Mobility for Older Canadians"
B5, Wednesday, March 2, 2016, 16:00 - 17:00
"Long-Term Care Facility Residents' Initial Experiences and Perceptions of Intelligent Power Wheelchairs"
Paper Session #2, Salon 3iv, Thursday, March 3, 2016, 11:05 - 11:20
"The CanWheel Power Wheelchair Outcomes Toolkit: Overview and Application"
E2, Friday, March 4, 2016, 08:30 - 09:30

S

Bonnie Sawatzky, PhD, Associate Professor, University of British Columbia
818 West 10th Ave
Vancouver, BC, V5Z 1M9
bonita.sawatzky@ubc.ca
"Does 'goal satisfaction' improve with personalized power wheelchair skills training?"
Paper Session #1, Salon 3i, Wednesday, March 2, 2016, 14:00 - 14:15
"The Clinician Scientist in the Seating and Mobility Clinic: A Foundation for Education, Research and Clinical Practice"
E5, Friday, March 4, 2016, 08:30 - 09:30

Richard Schein, PhD, MPH, Research Scientist, University of Pittsburgh
6245 Penn Ave. Suite 401
Pittsburgh, PA, 15206
rms35@pitt.edu
"Systematic Development of a Clinical Wheelchair Assessment Checklist"
Paper Session #1, Salon 3iii, Wednesday, March 2, 2016, 14:30 - 14:45

Vince Schiappa, B.Sc., Graduate Student Researcher, University of Pittsburgh
6245 Penn Ave. Suite 401
Pittsburgh, PA, 15206
vjs19@pitt.edu
"Systematic Development of a Clinical Wheelchair Assessment Checklist"
Paper Session #1, Salon 3iii, Wednesday, March 2, 2016, 14:30 - 14:45

Mark Schmeler, PhD, OTR/L, ATP, Assistant Professor, International Society of Wheelchair Professionals (ISWP)
6246 Penn Ave.
Pittsburgh, PA, 15206
schmeler@pitt.edu
"How to Develop a Contextually Appropriate, Reliable, and Valid Wheelchair Service Provision Assessment"
A3, Wednesday, March 2, 2016, 11:30 - 12:30
"Systematic Development of a Clinical Wheelchair Assessment Checklist"
Paper Session #1, Salon 3iii, Wednesday, March 2, 2016, 14:30 - 14:45

Irene Schmid, BA Industrial Design, MA Economics, Seating Technologist, Sunny Hill Health Centre for Children
3644 Slocan Street
Vancouver, BC, V5M 3E8
Irene.schmid@cw.bc.ca
"Heat Dissipation in a Custom Molded Seating System"
Paper Session #2, Salon 2iv, Thursday, March 3, 2016, 11:05 - 11:20

Gary Schroeder
gakaschroeder@gmail.com
"Progressive Conditions: The Personal Journey"
Plenary Panel, Thursday, March 3, 2016, 16:00 - 17:00

Mary Shea, OT, ATP, Manager, Kessler Rehabilitation
1199 Pleasant Vally Way
West Orange, NJ, 07052
mshea@kessler-rehab.com
"Does Wheelchair Configuration Make a Difference In Wheelchair Skills?"
Paper Session #1, Salon 2ii, Wednesday, March 2, 2016, 14:15 - 14:30

Sheilagh Sherman, B.A., B.H.Sc.O.T., M.H.M., Clinical Educator/Occupational Therapist, Sunrise Medical Canada
237 Romina Drive, Unit 3
Concord, ON, L4K 4V3
sheilagh.sherman@sunmed.com
"Transit Standards for Seating, Wheelchairs, and Wheelchair Tiedowns"
B6, Wednesday, March 2, 2016, 16:00 - 17:00

Alisa Silvestre
alisa.silvestre@gmail.com
"Progressive Conditions: The Personal Journey"
Plenary Panel, Thursday, March 3, 2016, 16:00 - 17:00

Eric Simoneau, CEO, Motion Composites
519 Rue J. Oswald Forest Unit# 101
St. Roch-de-l'Achigan, QC, J0K3H0
e.simoneau@motioncomposites.com
"When Wheelchairs Won't Roll: Top 10 Maintenance Tips for Perfect Manual Wheelchair Performance"
PS7, Tuesday, March 1, 2016, 13:15 - 16:30

Carina Siracusa, DPT, Physical Therapist, Ohio Health
5193 West Broad Street
Columbus, OH
Carina.siracusamajzun@ohiohealth.com
"Seating and Mobility for the Oncology Patient"
D6, Thursday, March 3, 2016, 14:10 - 15:10

Cher Smith, BSc OT, MSc, Occupational Therapy, Queen Elizabeth II Health Sciences Centre; Adjunct Professor, School of Occupational Therapy at Dalhousie University
1341 Summer St
Halifax, NS, B3H 4K4
cher.smith@nshealth.ca
"Using the Wheelchair Skills Test (WST) and Wheelchair Skills Test Questionnaire (WST-Q) to Assess Manual and Powered Wheelchair Users – A Practical Workshop"
A4, Wednesday, March 2, 2016, 11:30 - 12:30

Emma M Smith, MScOT, Occupational Therapist, PhD Candidate
4255 Laurel St.
Vancouver, BC, V5Z2G9
emma.m.smith@gmail.com
"Clinical Utility and Therapists' Perceptions of Shared Control for Powered Mobility Assessment and Training"
Paper Session #1, Salon 3v, Wednesday, March 2, 2016, 15:00 - 15:15

Sharon Sonenblum, Phd, Senior Research Scientist, Georgia Institute of Technology
490 10th Street NW
Atlanta, GA, 30318
Sharon.sonenblum@coa.gatech.edu
"Clinical Application of the Dispersion Index"
A6, Wednesday, March 2, 2016, 11:30 - 12:30
"You Got To Move It, Move It! Pressure Relief Behaviors and Weight Shifting Activities to Prevent Pressure Ulcers in Persons with SCI"
C6, Thursday, March 3, 2016, 13:00 - 14:10

Maureen Story, (Co-Chair) BSR (PT/OT), Therapy Department, Sunny Hill Health Centre for Children
3644 Slocan Street
Vancouver, BC V5M 3E8
mstory@cw.bc.ca
Opening Remarks, Wednesday, March 2, 2016, 08:30 - 08:50

Mikio Sumida, MD.PhD, Physiatrist, Aijinkai Rehabilitation Hospital
Hakubai cho 5-7
Takatuki city, Osaka, Japan, 569-1116
sumida@rondo.ocn.ne.jp
"A New Trial of All Rental Wheel Chairs and Walking Aid Devices in Kaihukuki (Subacute) Rehabilitation Hospital"
Paper Session #2, Salon 1i, Thursday, March 3, 2016, 10:20 - 10:35

Sharon Sutherland, PT, Physical Therapist, Seating Solutions, LLC
3555 Lakeshore Drive
Longmont, CO, 80503
sharronpra@msn.com
"The Other Seat! Where Else is Skin Integrity Preservation & Postural Management a Critical Consideration for the Wheelchair Seated Client? In The Bathroom of Course!"
F3, Friday, March 4, 2016, 09:40 - 10:40

Jeff Swift, CRTS, ATP, NuMotion
527 Grand Slam Dr
Evans, GA, 30809
jeff.swift@numotion.com
"Global RePurposing: A Model for Meeting the Needs of the Underserved Internationally"
Poster

Sharon Swift, EdD, Assistant Professor, Georgia Regents University
987 St Sebastian Way EC 2304
Augusta, GA, 30912
sswift@gru.edu
"Global RePurposing: A Model for Meeting the Needs of the Underserved Internationally"
Poster

Dave Symington, BA, Med, Writer, Musician, Co-founder, Vancouver Adapted Music Society
davesymington@hotmail.com
"Risk, Reward, and Reality"
Closing Plenary, Friday, March 4, 2016, 11:50 - 12:15

T

Stephanie Tanguay, BS in OT, Occupational Therapist, Motion Concepts
700 Ensminger Road
Tonawanda, NY, 14150
stanguay@motionconcepts.com
"Arthrogryposis -Challenges & Solutions When A Non Progressive Diagnosis Progresses"
B1, Wednesday, March 2, 2016, 16:00 - 17:00

Susan Johnson Taylor, OTR/L, Numotion
4140 Whiting Avenue - c/o Daley
Mt. Pleasant, SC, 60605
sjtaylor222@gmail.com
"Clinical Aspects of Aging with a Disability"
Plenary, Wednesday, March 2, 2016, 09:35 - 10:00

Toni-Marie Taylor, B.Sc.O.T., Account Manager/ Occupational Therapist, Sunrise Medical Canada
237 Romina Drive, Unit 3
Concord, ON, L4K 4V3
toni.taylor@sunmed.com
"Transit Standards for Seating, Wheelchairs, and Wheelchair Tiedowns"
B6, Wednesday, March 2, 2016, 16:00 - 17:00

Diane Thomson, OT, OTR, ATP, Rehab Institute Michigan
261 Mack Blvd
Detroit, MI, 48201
Diane.b.Thomson@gmail.com
"Laying the Foundation of Wheelchair Seating and Mobility Assessments"
PS2, Tuesday, March 1, 2016, 09:00 - 16:30

Laura Titus, PhD, Occupational Therapist
550 Wellington Road
London, ON, N6C0A7
laura.titus@sjhc.london.on.ca
"Applying Current Evidence to Clinical Practice for Pressure Management in Wheelchairs and Seating"
PS5, Tuesday, March 1, 2016, 09:00 - 12:15

Elaine Vivianne Toskos, MAOTR/L, Clinical Specialist-Occupational Therapy, Rusk Rehabilitation- NYU Langone Medical Center
240 East 38th Street Room#1718B
New York, NY, 10016
elaine.toskos@nyumc.org
"Wheeling in the City: Mobility & Environmental Access Considerations across the Globe"
F5, Friday, March 4, 2016, 09:40 - 10:40

Patricia Tully, BS Health Education, BSOT, OTR, ATP, TIRR
1333 Moursund
Houston, TX, 77030
Patricia.tully@memorialhermann.org
"Laying the Foundation of Wheelchair Seating and Mobility Assessments"
PS2, Tuesday, March 1, 2016, 09:00 - 16:30

V

Linda Valent, PhD, Senior researcher/ Occupational therapist, Heliomare Rehabilitation Centre
Relweg 51
Wijk aan Zee, Netherlands, The Netherlands, 1949EC
l.valent@heliomare.nl
"Experienced Fatigue, Pain and Instability During Sitting in Persons with Chronic Spinal Cord Injury"
Paper Session #1, Salon 2v, Wednesday, March 2, 2016, 15:00 - 15:15

Bart Van der Heyden, PT, Independent PT, De Kine
Henri Van Cleemputteplein 19
Sint-Amandsberg, Belgium, 9040
Info@super-seating.com
"What's in the Trunk? Examining Trunk Posture, Stability and Outcomes"
A2, Wednesday, March 2, 2016, 11:30 - 12:30

Pooja Viswanathan, PhD, Post doctoral Fellow, Toronto Rehabilitation Institute
500 University Ave
Toronto, ON, M5G 1V7
poojavish@gmail.com
"CanWheel: Improving Power Wheeled Mobility for Older Canadians"
B5, Wednesday, March 2, 2016, 16:00 - 17:00
"Smart Wheelchairs in Assessment and Training: Findings from a Consensus Workshop"
Paper Session #2, Salon 3v, Thursday, March 3, 2016, 11:20 - 11:35

W

Ginger Walls, PT, MS, NCS, ATP/SMS, Clinical Education Specialist/Physical Therapist, Permobil
722 Fairhaven Road
Tracys Landing, MD, 20779
ginger.walls@permobil.com
"Standing Up to Complications of Spinal Cord Injury/ Disease"
B3, Wednesday, March 2, 2016, 16:00 - 17:00

Rosalie Wang, PhD, Assistant Professor, University of Toronto
500 University Ave.
Toronto, ON, M5G 1V7
rosalie.wang@utoronto.ca
"Smart Wheelchairs in Assessment and Training: Findings from a Consensus Workshop"
Paper Session #2, Salon 3v, Thursday, March 3, 2016, 11:20 - 11:35

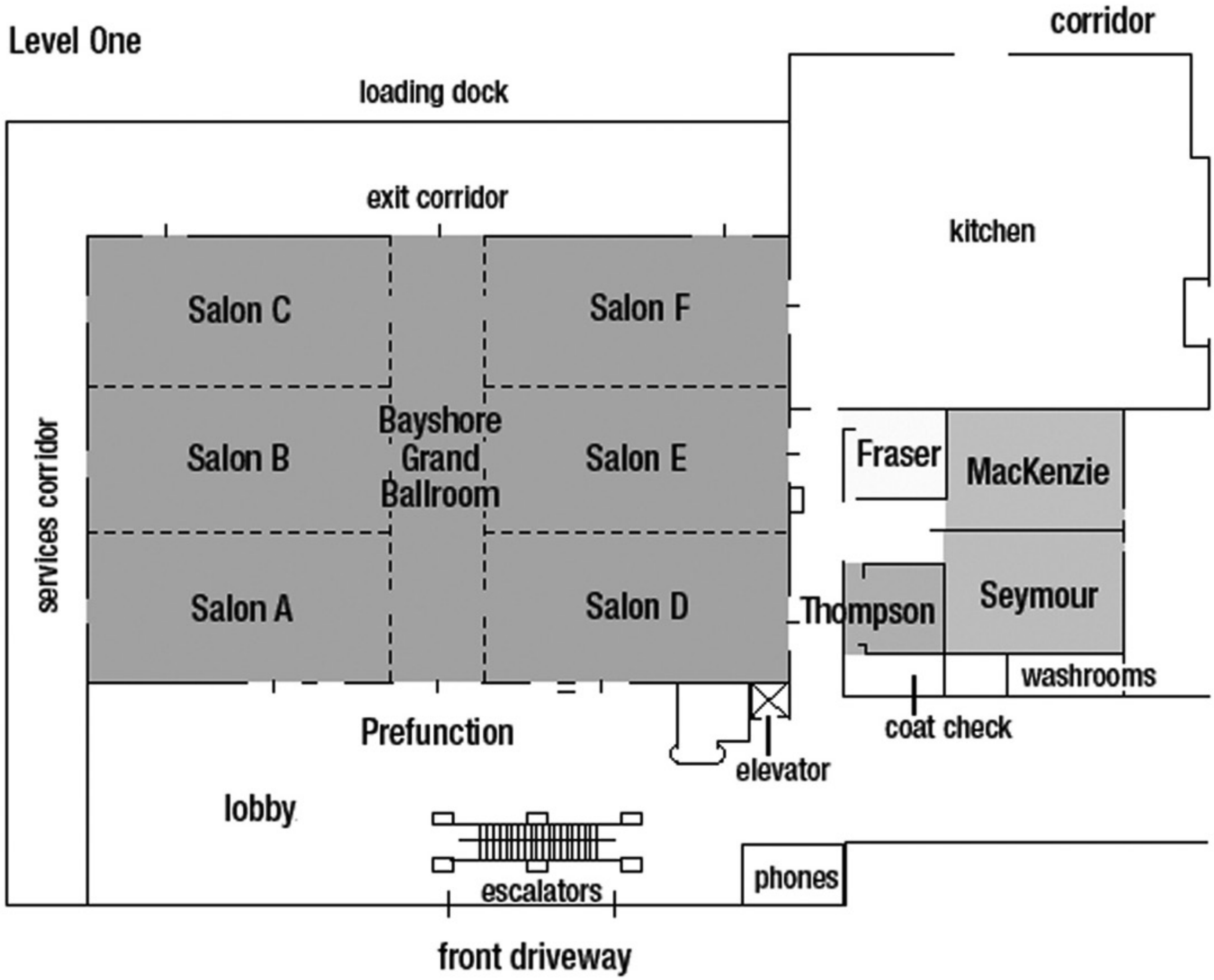
Kelly Waugh, PT, MAPT, ATP, Senior Instructor/Clinic Coordinator, University of Colorado Denver
601 E. 18th, Suite 130
Denver, CO, 80203
Kelly.Waugh@ucdenver.edu
"Using Biomechanical Principles in the Management of Complex Postural Deviations in Sitting"
PS1, Tuesday, March 1, 2016, 09:00 - 16:30
"ISO Performance Standard for Postural Support Devices: What Should I Know?"
C2, Thursday, March 3, 2016, 13:00 - 14:10

Y

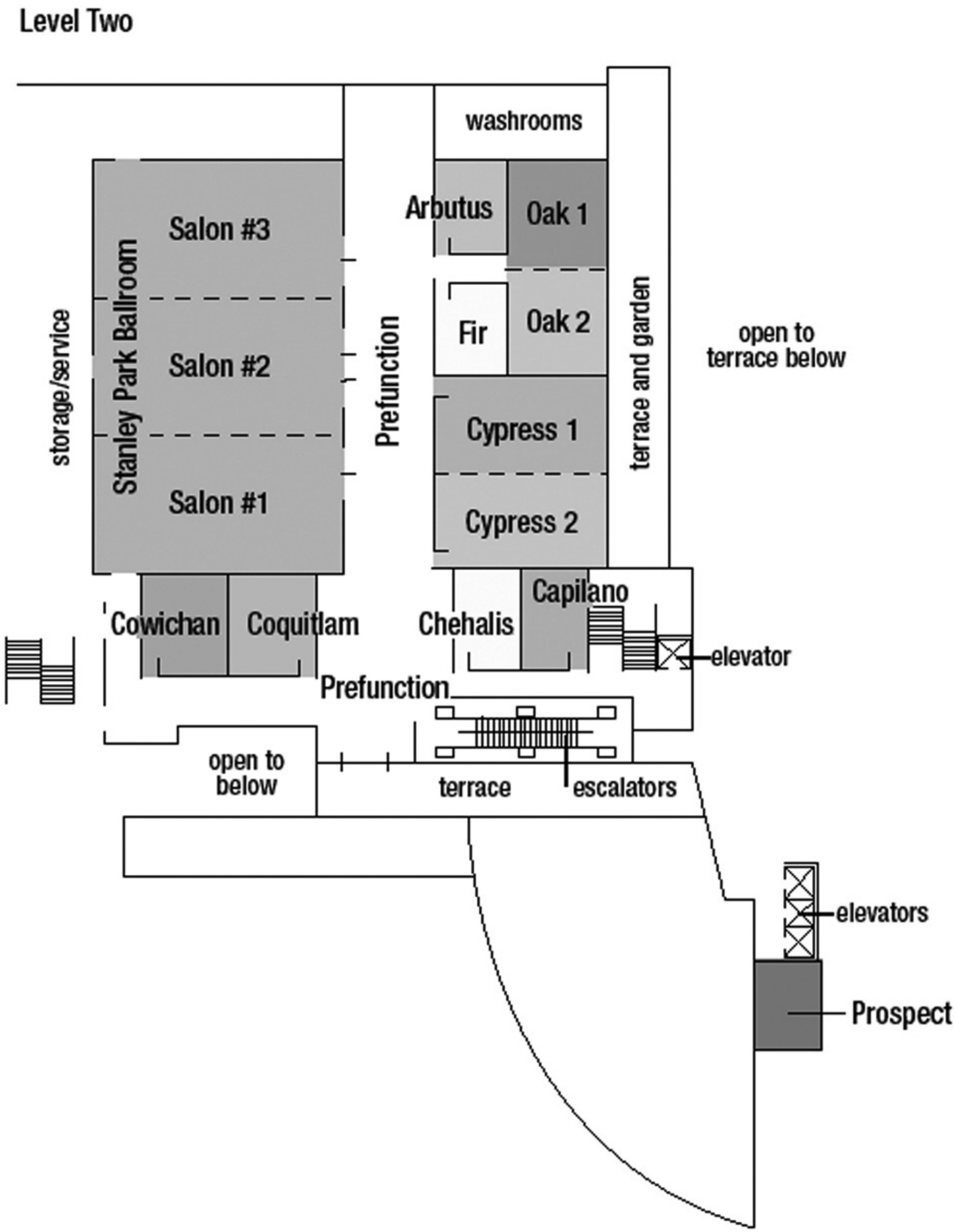
Hongseon Yang, PO, Sequence Co.Ltd
Hakubai cho 5-7
Takatuki city, Osaka, Japan, 569-1116
"A New Trial of All Rental Wheel Chairs and Walking Aid Devices in Kaihukuki(Suacute)Rehabilitation Hospital"
Paper Session #2, Salon 1i, Thursday, March 3, 2016, 10:20 - 10:35

Joanne Yip, BSR, Occupational Therapist, GF Strong Rehab Centre and Access Community Therapists Ltd.
4255 Laurel Street
Vancouver, BC, V5Z 2G9
ngyip2@gmail.com
"Seating the Client with Complex Needs"
PS3, Tuesday, March 1, 2016, 09:00 - 16:30
"Seating for Pressure Management"
E4, Friday, March 4, 2016, 08:30 - 09:30

Meeting Room Layout



Meeting Room Layout



Creative Accessibility and Motivation to Embrace Our Dreams

Linda McGowan

Aging with a Disability: An Overview of Clinical Aspects

Susan Johnson Taylor, OTR/L

I have an affiliation with a Complex Rehabilitation Supplier company, Numotion, as the Manager of Training and Education

Whether the clinician is an individual who works with children or adults, the topic of aging with disabilities is relevant to practice. With adults, this revolves around issues that can arise as they age. With children, it is understanding the same issues to assist in molding current treatment. The clinician's ability to do this revolves around being armed with information, a willingness to listen more and talk less and the ability to ask open-ended questions without judgement. Everything that we do is informed by our past experiences with clients, and this is no exception! Each client who you see who is aging with a disability brings new insights and information to subsequent clients.

There is now a substantive body of information regarding aging with disabilities that can assist clinicians in asking pointed questions. For example, a study by Thompson and Yakura revealed that 78% of 54 clients who had a functional decline had new equipment identified by a therapist after an evaluation whereas on 10% of those clients recognized that need before (Thompson and Yakura, 2001). Additionally, these same authors looked at 600 people who had identified they were having pain, fatigue and weakness as a constellation of symptoms. They recognized that this led to major functional changes and called it "Functional Impairment Syndrome".

As clinicians, we are taught to interview, record and synthesize information to solve problems. The steps do not change when working with an individual who is aging with a disability, but the length of them may due to the complexities involved. How questions are asked during the evaluation is of utmost importance: there should be an expectation on the part of the client that information is being provided but the ultimate decision is theirs, without judgement. When a client has been using equipment and engaging in ADL and functional skills in a certain way for many years, the use of trial equipment in multiple environments becomes a necessity.

It behooves the clinician to access articles relevant to the populations with whom they work. The evidence and information in these publications can provide valuable insight during clinical interventions.

Thompson and Yakura. 2001. Aging related functional changes in spinal cord injury. *Topics in Spinal Cord Injury Rehabilitation,* 6 (3) 69-82.

Related reading:

Andersson and Mattson. (2001). Adults with cerebral palsy: a survey describing problems, needs and resources with special emphasis on locomotion. *Developmental Medicine and Child Neurology,* 43, 76-87.

Chen, et al. (2005). Pressure ulcer prevention in people with spinal cord injury: age-period-duration effects. *Archives of Physical Medicine and Rehabilitation,* 86, 1208-13.

Colantino et al. (2004). Aging with traumatic brain injury: long term health implications. *International Journal of Rehabilitation Research,* 27, 209-214.

Cook, at al. (2011). Fatigue and aging with a disability. *Archives of Physical Medicine and Rehabilitation,* 92, 1126-1137.

Haak, at al. 2009. Cerebral palsy and aging. *Developmental Medicine and Child Neurology,* 51, (Issue supplement 4) 16-23.

Hitzig, at al. Aging following spinal cord injury, in: (2010) Eng, et al. eds. SCI Rehab Evidence. Volume 3.0. Vancouver, BC. pg 17. Retrieved from: http:// www.scire.com.

Kemp and Mosqueda, eds. 2004. Introduction. Aging with a disability: what the clinician needs to know. Johns Hopkins University Press, Baltimore, MD.

Smart Wheelchairs: Why They Are (and Why They Aren't) Almost Here

Ian M Mitchell
Department of Computer Science
University of British Columbia
Vancouver, BC, Canada

I, Ian M. Mitchell, do not have an affiliation (financial or otherwise) with an equipment, medical device or communications organization.

Introduction

For persons with mobility impairments who are unable to propel a wheelchair manually, powered wheelchairs (PWCs) can provide independent mobility, increase participation in activities of daily living and improve quality of life. Unfortunately, those with additional sensory, dexterity and/or cognitive impairments are—or are conservatively perceived to be—unable to operate these large, heavy and powerful devices safely, which can lead to PWC exclusion and in turn to reduced mobility and independence.

Research on PWCs with robotic navigation and collision avoidance assistance dates back decades, and has even generated a small number of commercial products; however, none have succeeded as assistive devices. Perhaps more frustratingly, recent media coverage proclaims that every car manufacturer is urgently pursuing the self-driving automobile, Google has dozens driving the streets of California, Tesla owners can now press an "autopilot" button, and Apple is doing *something*... If a robot driver can handle several tons of metal traveling at highway speed despite the complexities of internal combustion engines, multi-gear drivetrains, anti-lock and stability control brakes, multipoint suspensions, radial tires, varying road surfaces, bad weather, and darkness, then ensuring the safe navigation of an indoor PWC at pedestrian speed should be child's play.

Smart Wheelchairs: Coming soon to a care facility near you?

Fielding a smart PWC which enables the mobility of persons who might otherwise be excluded from independent mobility due to cognitive, sensory and/or dexterity impairments will require overcoming a number of challenges including regulatory, legal, economic, commercial, and technological. I focus here on the technological challenges because the advent of self-driving cars will soon provide a framework by which the others can be resolved. California and Nevada already allow licencing of self-driving vehicles. Google's cars have been involved in 17 accidents to date; none have been the robot's fault but eventually we will see court action and consequent case law. The necessary sensors do increase the price of vehicles, but costs have been dropping dramatically due to intense R&D efforts and economies of scale, and the "wealthy senior" market segment is only growing in size. The cost of R&D and potential liability may make vendors hesitant to act, but autonomous mobility is a killer app: none of the big manufacturers were seriously invested in self-driving cars until Google started talking commercialization, and now everybody (including Google) is desperately playing catch-up.

Although it may take some years yet, the enormous benefits of reduced accidents and reclaimed time proffered by self-driving cars are such that these essentially social challenges will inevitably be resolved now that the technological impediments are finally being overcome. These resolutions will then provide guidance on the similar issues in the context of smart PWCs.

Technological Challenges for Smart Wheelchairs

So what about the technology: Are safe self-navigating PWCs possible? In fact, chairs exist which can construct a map of a building and navigate themselves within it while avoiding obstacles. At present they require a halo of expensive sensors to understand their local environment, but those costs will decrease. However, this paragraph started with the wrong question. The right question is: Do wheelchair users want the kind of hands-off, point-to-point delivery being promised by the self-driving car?

I will argue that the smart wheelchair must share control over movement in a much more interactive fashion than a self-driving car, and that the correct design of this shared control is the most significant challenge facing smart wheelchairs which will not be solved without the help of wheelchair mobility experts and members of the target population because nobody else is going to solve a similar problem.

A control policy which continuously integrates both robotic and user input is desirable for a number of reasons. The foremost is that it maintains the user's sense of control and encourages them to stay engaged with their environment, which is one of the goals of independent mobility, and is particularly important for users with cognitive impairment. With the user continuously "in-the-loop", it is possible to learn the destination as the trip progresses, rather than needing to know it in advance. The shared control can also help to resolve the continual small ambiguities which arise in the relatively unstructured environment in which PWCs must navigate (in comparison with cars, which must follow traffic rules). Because the robotic component of the smart wheelchair makes fewer of the decisions, there is less need to communicate the reasons for these decisions back to the user and hence less demand on the limited sensory capacity of the user. Finally, a shared control system could provide the user with a continuum of support levels—from merely collision avoidance in an emergency all the way to nearly complete self-navigation—which could be adapted to the changing capabilities and desires of the user during a single day or over the course of years.

Initial testing with smart wheelchair prototypes supports these assertions: users do not like systems which abruptly (and somewhat mysteriously) stop to avoid collisions, appreciate systems which smoothly adjust the steering to avoid obstacles and/or accomplish short-term tasks, and have mixed feelings about the PWC performing those same tasks independently (even when it does so perfectly).

It will take time to resolve this shared control challenge; fortunately, this small community can focus on it while the enormous automobile industry uses its clout and dollars to sort out most of the rest.

So What Can a Smart Wheelchair Do Now (or Soon)?

Decades of unfulfilled promises may have damped excitement around the future of the smart wheelchair, and a truly smart specimen is not going to debut at the next ISS. The same is true of smart cars, but that has not stopped some features from appearing in showrooms near you. Sensors can provide 360° awareness of potential collisions. Maps can permit wayfinding support. Well-defined short-term tasks, such as parking, can be accomplished automatically. These capabilities are proving increasingly popular in cars. The people who attend ISS will play a large part in determining when they break through into the PWC market.

Primary Contact

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A1: Product Design Innovation

Susan E Farricielli
Kinetic Innovative Seating System [KiSS]

I, Susan Farricielli, am the managing partner of Kinetic Innovative Seating System LLC and the developer of the KiSS dynamic seating system. I am responsible for design, research, development and clinical studies pertaining to the KiSS dynamic seating system. I own the patent and provisional patent and share ownership of the Company.

Introduction:
How many of you have recognized a problem and thought of a solution? Who has said, “there must be a better way to do this” or “I can’t believe nobody has invented a machine or a device that makes this less complicated?” This is because many problems are common to us all and eventually someone will develop a solution. All of us are capable of having new ideas and using them to solve problems. As a practicing industrial designer, and university professor, I can attest that ideas come from individuals of all ages and all walks of life.

Discussion:
Product design is a relatively new profession--less than 100 years old. The birth of product design, or “industrial design” followed the industrial revolution, which provided many opportunities for the commercialization of consumer products.

Product design includes both engineering and art, hence its name, “industrial arts.” A product designer designs objects for manufacture that are typically 3-dimensional and are often highly technical. Most products are created by a team of specialists. A product designer needs a manufacturer and a market to realize his or her creation.

Some of the pioneers of industrial design are Raymond Loewy, Henry Dreyfuss, Norman Bel Geddes, Walter Dorwin Teague and Charles Eames. Some built large design practices and influenced future generations of product designers. In 1944, they founded the Society of Industrial Designers with 15 members. That organization is now the Industrial Designers Society of America (IDSA) with approximately 2,800 members.

During WWII, there was a shortage of metal. The US government approached Charles and Ray Eames to create a leg splint out of wood. This experience led them to design chairs and furniture molded in plywood, and later from synthetic composites. Eames chairs remain in production today.

Niels Diffrient, was Eames’ colleague at Cranbrook Academy. He first began designing chairs for the architect, Eero Saarinen. Diffrient joined Henry Dreyfuss Associates where he designed airplane interiors, tractor seats, and the publication, Human Scale. He specialized in ergonomic seating.

Other seating designers include: William Stump and Donald Chadwick, who created the Aeron Chair for Herman Miller, and Giancarlo Piretti, who with Emilio Ambasz, designed the Vertebra Chair for Kreuger International (KI) and other chairs that feature motion in the seat. These designers have created effective seating solutions that are ergonomic and self-adjusting to the human body. This kind of seating is known in the furniture industry as “task seating.” There are many task seating designs on the market today, and I will cover them in my presentation.

A product will always evolve as it is developed and it will continue to evolve over its lifetime. It may one day become extinct or it may morph into another product. It could also reappear as vintage style. Some of the factors that affect a product's evolution include: Technology, human factors, culture, fashion, regulations, climate and geography.

A product will never be everything to everybody. The product needs a development strategy with design constraints. Pre-conceptions should be kept to a minimum. It is important to remain open to all ideas throughout the design process. Problems can be viewed as opportunities. When the problems are solved, the design will follow.

A new product or invention may resemble another product before its unique qualities are discerned. For example, one of the first Apple computers was encased in wood; early kitchen appliances, such as the stove, resembled Victorian furniture, before becoming streamlined by manufacturing processes; eyeglasses were functional, not fashionable. Product features can cross over into another product. A telephone can have a watch and a watch can become a telephone. Self-adjusting task force seating can be put into a wheelchair and the wheelchair is transformed.

A design strategy begins with a clearly stated description of the problem. This is sometimes referred to as a *Design Brief*. The Design Brief should include the following: (1) A description of the problem; (2) A description how the problem is currently being addressed; (3) A list of products on the market that address this problem, including positive and negative features and their respective market prices; (4) A description of the intended user and how the product will be administered; (5) A list of any regulatory requirements; and (6) Any broad implications for the problem. For instance, the office furniture industry recognized that people who sit in rigid chairs all day, experience back pain, resulting in high medical bills and loss of work. This resulted in the development of self-adjusting task seating.

Assemble a team and include a product designer. Have a "brain-storming session" that will provide feedback and criticism to help generate ideas. Write the Product Design Specifications (PDS). The PDS establishes the groundwork for all engineering design activities and ensures that all relevant factors concerning the product are considered. I will include a PDS outline in my presentation.

Collect, compile, organize and document the progress of your design, using a format that can be easily understood and followed. This documentation will not only provide helpful points of reference as the product evolves, it will be the basis of the Design Controls required by the United States Food and Drug Administration and other regulatory agencies.

Consider making incremental changes, so that details are not lost in the process. Build prototypes to test your ideas. Include images and test results with your documentation. While an engineer can perform a finite element analysis (FEA) on a computer model to simulate impact and forces, a physical model, or prototype will prove the product's durability, how the user will interact with it and how it will be manufactured. Document everything so the design evolution process can be repeated.

Protecting your Intellectual Property (IP). A Non-Disclosure Agreement (NDA) should be used for presenting an invention or idea to a potential partner, investor, or distributor. It should also be used when receiving services from a company or individual who may have access to sensitive information. Employees with access to confidential and proprietary information should also sign a NDA.

Patents. When an individual is working for a company or institution, innovations are commonly considered “work for hire” and the patent would typically belong to the employer or institution. If a patent results from the employees work, the employee would be named on the patent. This arrangement is usually described in your employment contract and may be negotiable. Don’t lose your rights!

Patents are expensive. There are filing fees, attorney fees and maintenance fees. It is always good to ask permission of your employer before patenting anything. In order for something to be patented, it must be new, useful and “non-obvious.” Improvements to existing patented inventions comprise the most filed patent applications.

A Utility Patents may be issued for machine, manufacture, composition of matter, or process. Utility Patents, commonly have multiple claims, protect functionality and are good for 20 years from the filing date. A Design Patent is a single claim for aesthetic or ornamental aspects of an object and it is protected for 14 years.

A Provisional Patent allows the applicant(s) to explore their market for a year to determine the commercial viability of the invention. The utility patent application and foreign applications must be filed before the year is up. Nothing new can be added to the utility application.

See the United States Patent and Trademark Office website: USPTO.gov

Manufacturing. Selected tests required for regulatory purposes must be performed on the production units. Develop prototypes in a way that permits low-volume pilot manufacturing. These methods can be explored on the Internet. Begin by investigating sources that manufacture parts similar to those in the new product. Talk with manufacturers and suppliers to access their capabilities, costs and reputation. In manufacturing, the unit cost of a part will go down as the volume goes up. Some manufacturing methods are more costly than others.

It may be more desirable to sell or license the invention to a manufacturer, however, a manufacturer will not want to gamble on a product that has not been proven in the market, nor does every manufacturer have the resources for Research and Development (R&D). However, medical professionals have the ability to research, test and develop products and can become team members in the design process.

Funding. Partnering with industry may be one way to fund an idea. At the Rhode Island School of Design (RISD), the Industrial Design department undertook the re-design of the Blood Mobile. It was a 5-year design project and it was an excellent opportunity for students to have first-hand experience in the collaborative design process, sponsored by the Red Cross. RISD also participated in the development of the “Universal Kitchen” design, that was sponsored by Maytag and Frigidaire and was showcased in the exhibit, “Unlimited by Design,” at the Cooper Hewitt Museum in 1998. These kinds of projects, sponsored by industry, can create a revenue stream, and in the case of their kitchen design, RISD sold the design rights to Maytag.

Other sources of funding include Venture Capitalist and Angel Investors, as well as private, state and federal grants. The United States National Institutes of Health (NIH) offers grants for Small Business Innovation Research (SBIR) and Small Business Technology Transfer Research (STTR) as does the Veterans Administration, the National Science Foundation and the Department of

Defense. Grants.gov offers a listing of grant solicitations. Even if funding is not obtained, critical feedback from experts will be provided.

Conclusion: Product Design Innovation requires an understanding of the process of design for manufacturing. In addition, a strategy, collaboration and funding are necessities in order to bring an idea from concept to a finished product.

A2: What's in the Trunk? Examining Trunk Posture, Stability and Outcomes

Bart Van der Heyden, PT
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I, Bart Van der Heyden, have had an affiliation in the past two years with Bodypoint in regards to providing clinical application education. This affiliation will not produce a conflict of interest in regards to the presentation at hand since this presentation is clinical and NOT product related.

Introduction:
Simple thoracic seating interventions can have a major impact on the client's head position, upper extremity function, sliding when seated and overall seating comfort.

Thoracic seating interventions may involve adjustments of posterior thoracic region, anterior thoracic region and lateral thoracic region, either symmetrical or asymmetrical. Both primary and secondary support systems may be used to impact these areas.

Thoracic interventions can be altered by adjusting wheelchair recline and tilt, adjusting back supports, lateral supports and anterior trunk supports.

Discussion:
Findings from the seating evaluation will help to determine how each body segment interacts with another and which intervention at the thoracic support area is most beneficial to meet the client's goals. Key points from the physical evaluation are to determine:

- If the client has a fixed or flexible kyphosis
- If the client has a fixed or flexible scoliosis
- What the mobility is of the lumbar spine, cervical spine, pelvis and hips
- What is the client's seating balance

Case reports of wheelchair users with neuromuscular kyphosis and scoliosis will be reviewed to demonstrate the impact of adjusting different thoracic support areas on the client's head position, upper extremity function and sliding tendency.

Following each seating intervention, the benefits of a follow up program for each client of postural training for maintaining long term functional ability will be discussed.

Conclusion:
By adjusting the wheelchair recline and tilt, adjusting back support, lateral supports and anterior trunk supports for each wheelchair user, the client's head position, upper extremity function, sliding when seated and overall seating comfort can be improved.

Learning objectives:
- Describe the impact of different adjustments of each thoracic region on sliding, seating tolerance, head position and upper extremity function
- Discuss at least 4 thoracic postural interventions for dealing with common seating challenges.
- Be able to advise and implement a postural intervention plan for users with common seating challenges for maintaining posture and long term functional ability.

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A3: How to Develop a Contextually Appropriate, Reliable, and Valid Wheelchair Service Provision Assessment

Alexandria Miles, Mary Goldberg, Rachel Gartz, Jon Pearlman, Mark Schmeler

I, Alexandria Miles, do not have an affiliation (financial or otherwise) with an equipment, medical device, or communications organization.

Introduction

Mobility allows for independence in activities of daily living such as dressing, bathing, and eating, and is a gateway to societal participation, affecting one's ability to earn an education or income. Currently, the World Health Organization (WHO) estimates 70 million people around the world are in need of a wheelchair to be mobile.[1] Even for the portion who do have a wheelchair, a significant number are likely to use poorly-fitting or inappropriate wheelchairs, which put them at risk for secondary injuries and high likelihood of abandoning the technology.[2] To improve wheelchair users' community participation, especially in developing countries, it is important that healthcare professionals and others providing wheelchairs are well trained and possess knowledge in wheelchair service provision by proof of certification.[3]

The importance of certification is evidenced in nearly all healthcare domains; however, because wheelchair prescription is an emerging profession, a standard of certification and training has not yet been established. Wheelchair prescription requires unique skills and experience and may be sparsely included in pre-professional health science programs. Using occupational therapy (OT) standards as an example, the graduate must be able to train patients "to enhance functional mobility, including...wheelchair management" but does not specify other wheelchair service provision practices such as the initial intake assessment, the spectrum and type of device, how to incorporate contextual or environmental factors, nor quantity of the content or how it should be delivered.[4](p25) Likewise, although equipment and assistive devices are covered in the National Physical Therapy Exam (NPTE), there is no section regarding seating and mobility in particular.[5] Thus, existing programs may not guarantee in-depth seating and mobility training and competency.

As a consequence, wheelchair assessment and prescription issues may arise. Trainings and guidelines have been developed for wheelchair prescription best practice to mitigate this problem; however, until recently, there was no international test available assessing students' or professionals' knowledge of wheelchair provision. Although the Rehabilitation Engineering Society of North America (RESNA) Seating and Mobility Specialist (SMS) certification recognizes demonstrated competence in seating and mobility, the SMS is focused on North American policies, is only available in the English language, requires previous certification (Assistive Technology Professional) and 1,000 hours of service, is cost-prohibitive and may not be contextually appropriate for people in the developing world. Though as evidenced by the SMS, separating wheelchair prescription into its own specialty can allow for increased attention on the specifics of appropriate fitting.[6] Thus, an interdisciplinary and contextually-appropriate certification would benefit professionals, wheelchair users, and clinical outcomes around the world by establishing a benchmark to drive the improvement in training which vary widely and may have a consequential impact on the quality of service provision.

The study presented is aimed at the development of a basic test as a preliminary step towards establishing a certification process for wheelchair service professionals, one of the goals of the newly formed International Society of Wheelchair Professionals (ISWP).[7] The following will explain the process used to create and validate the test in order to professionalize the wheelchair service provision field. At the conclusion of the instructional session, participants should be able to do the following:

1. Identify key steps in assessment development.

2. Describe the components of a contextually appropriate, reliable, and valid assessment.

3. Identify methods used for assessment validation.

Methods

The test development approach was driven by an appointed Assessment Development Task Force (ADTF) composed of key stakeholders and included six key steps: domain selection, question development, alpha testing, beta testing, pilot testing, and evaluation.[8](p20) Domains are critical to an assessment as components are isolated to test the core knowledge, competency, and proficiency of the subject matter. The basic test domains were based on the World Health Organization's (WHO) internationally accepted guidelines for basic wheelchair service, which is supported by substantial research and evidence-based practice. These domains include *assessment*, *prescription*, *fitting*, *production*, *user training*, *process*, and *maintenance and repair*.

After domain selection, question development was initiated by ADTF and psychometricians from The Institute for Performance Improvement (TIfPI). TIfPI first provided ADTF with question development training and guidance with defining test objectives, including how test takers should be able to use their knowledge, what kinds of questions should be included, and how long and difficult the test should be. The question material included information from several sources and field experiences in order to ensure test takers were proficient working in settings that provided wheelchair provision services. The ADTF determined the best test format (multiple choice) and ensured test questions were unbiased. After questions were drafted, they underwent iterative revisions by the task force to ensure all were as clear as possible, that only one of the answer options was correct, and that they conformed to the style rules used throughout the test.

Upon test questions being revised and finalized, the assessment was placed on an online testing platform and entered the alpha testing phase. During this phase, in-house personnel independent of the task force completed the assessment to ensure test reliability. Test reliability refers to the consistency of the test for the in-house group via Internet as locations varied representing three different continents. Next, beta testing was conducted. During beta-testing, the test was released to selected wheelchair sector novices and experts worldwide to ensure test validity or accuracy and contextual relevance. In this phase, statistical analysis was used to determine the amount of time given to complete the test, to remove underperforming questions, and to recommend a pass/fail cut-off score.

Pilot testing subsequently followed, and subjects were recruited by asking clinic supervisors from 6 continents working in wheelchair provision services to select staff to participate. Unlike the beta test, participants were not selected based on expertise; however, inclusion criteria included participants be familiar with wheelchair provision to some degree. The final step, evaluation, was implemented by the International Society of Wheelchair Professionals (ISWP), who was also responsible for launching the final version of the test via the online platform. The evaluation phase is ongoing throughout the life of the assessment which allows ISWP to continuously evaluate participant results in relation to demographics, analyze individual question performance, and select all test parameters and procedures which are updated on an as needed basis.

Discussion and Recommendation
Through implementing the above steps and processes, the Wheelchair Service Provision - Basic Test was created. The test will aid clients, organizations, and health professionals worldwide in finding qualified wheelchair professionals since, currently, no other standard exists to unite wheelchair service organizations and professionals internationally under guiding principles. The test provides a foundation for training wheelchair professionals and supports standardized, freely-accessible wheelchair services anywhere in the world. To date, 275 wheelchair professionals have taken the basic test with a pass rate of 73%. Futhermore, the test is currently available in English, Albanian and Khmer. Spanish, French, and Portuguese will be available soon, and several other languages are in the beta testing phase.

The International Society of Wheelchair Professionals is confident the technique used in developing the Wheelchair Service Provision – Basic Test is the best practice for developing a contextually appropriate valid and reliable test, therefore, recommends the following for professionals looking to develop an assessment for their respective discipline:

1. Appoint and develop an assessment task force composed of key stakeholders.

2. Identify competency domains founded on extensive research and evidence-based practice.

3. Engage stakeholders in question development training and define assessment objectives.

4. Include and consider all sources within the respective discipline to develop unbiased test questions.

5. Review and revise questions and answers for clarity.

6. Conduct alpha testing using in-house personnel to establish reliability.

7. Conduct beta testing using subject matter experts to establish validity.

8. Revise test based on results of beta test using statistical analyses and recommend a cut-off score.

9. Conduct pilot testing with a sample of the target population.

10. Launch final test and continuously evaluate and analyze test materials, protocol, and performance.

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A4: Using the Wheelchair Skills Test (WST) and Wheelchair Skills Test Questionnaire (WST-Q) to Assess Manual and Powered Wheelchair Users – A Practical Workshop

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Disclosures
I (R Lee Kirby) do not have an affiliation (financial or otherwise) with an equipment, medical device or communications organizations.

I (Cher Smith) do not have an affiliation (financial or otherwise) with an equipment, medical device or communications organizations.

Learning Objectives
Participants will be able to:
1. Describe the Wheelchair Skills Test (WST) and the Wheelchair Skills Test Questionnaire (WST-Q) and the research evidence underlying them.
2. Access the WST and WST-Q Manuals and related forms from the Wheelchair Skills Program website.
3. Implement the WST and WST-Q in their own settings.

Overview of Instructional Session
During the session, we will briefly review the theoretical background and published evidence regarding the WST and WST-Q. However, the main body of the session will be practical with the participants using the WST-Q forms to assess themselves and the WST forms to assess videotaped demonstrations of manual and powered wheelchair users actually completing the tests.

Background
The WST and WST-Q are objective and questionnaire versions of assessment protocols that can be used for manual wheelchairs, powered wheelchairs or scooters operated by their users or caregivers.

The WST and WST-Q test a subject's ability to perform a representative set of skills and, in the case of the WST-Q, confidence in performing the skill and the frequency with which these skills are performed. The WST and WST-Q each have advantages and limitations, summarized in the Table below.

Table. Comparison of WST and WST-Q

Consideration	WST	WST-Q
Time to administer	~30 minutes	~10 minutes
Obstacles needed	Yes	No
Space needed	~1000 sq feet	None
Induces a training effect	Probable (~5%)	None known
Can assess capacity (*can* do)	Yes	Yes
Can assess confidence	No	Yes
Can assess performance (*does* do)	No	Yes
Simulated vs real setting	Simulated usually	Real
Affected by missing equipment	Yes	No
Likelihood of failing a skill on a technicality	Occasional	None
Degree of specificity of settings	High	Low
Possibility of a testing error	Occasional	Rare
Can be administered by phone	No	Yes
Can be administered by mailed questionnaire	No	Yes
Can be administered on-line	No	Yes
Can be completed by a proxy	No	Yes
Requires ability to follow instructions	Yes	No
Requires ability to communicate	No	Yes (unless proxy)
Potential to misrepresent functional level	Low	Slightly greater
Provides detail about *how* skills performed	Yes	No
Risk of injury	Minimal	None
Total scores	Slightly lower	Slightly higher

The complementary benefits of the WST and WST-Q can be captured by using them in combination – “Can you do it? How confident are you? How often do you do it? Show me how”.

Take-home message
The WST and WST-Q are simple, safe and inexpensive measures that are freely available on-line. Their measurement properties have been well studied. On completion of the session, attendees will be better able to implement the WST and WST-Q in their own settings.

References

1. Details about the WST and the WST-Q are provided in the WSP Manual and forms that can be downloaded from http://www.wheelchairskillsprogram.ca/eng/manual.php.

2. As of January 11, 2016, there were 48 published peer-reviewed papers about the WST and WST-Q or about research studies that have used these measures as outcomes. These can be found in a dynamic link that is automatically updated at http://www.wheelchairskillsprogram.ca/eng/publications.php.

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A5: Power Wheelchair Driving Methods for People with Muscle Weakness

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I, Michelle Lange, have a financial affiliation with Stealth Products during the past two calendar years. I provide continuing education for this company for which I am compensated.

Introduction
Many people with muscle weakness are unable to be independently mobile without the use of a power wheelchair. Use of a standard joystick is not always feasible at all or long-term, however a variety of alternative proportional and digital driving methods are available which require less active range of motion and force to control. Programming specific driving and driving method parameters is also critical to provide independence and reduce effort.

Diagnoses Characterized by Muscle Weakness
Many diagnoses are characterized by muscle weakness, however people with the following diagnoses frequently require a power wheelchair: muscular dystrophies, spinal muscular atrophies (SMA), congenital myopathies and amyotrophic lateral sclerosis (ALS).

People with Duchenne muscular dystrophy may require a power wheelchair in the early teen years. Duchenne's is characterized by resistance to change and about 70% of people with this condition also have some cognitive involvement. This needs to be considered in the evaluation as these clients may be resistant to changing their driving method and have some difficulty learning new skills, such as learning how to use a new driving method or other power wheelchair features. People with this diagnosis often have better motor control if the driving method is midline and close to the body.

Some of the very youngest power wheelchair drivers are children with spinal muscular atrophy, type 1. There are four primary types of SMA. Children with type 1 SMA typically do not survive their first year without ventilation and have very limited movement and strength. Children with type 2 SMA may not require a power wheelchair until late elementary school, but this can vary. Cognition, sensation and vision are unaffected. As the prognosis is predictable and other skills are not impacted, early power wheelchair recommendation is common. When recommending a driving method, it is important to capture body movements that are mostly likely to persist despite ongoing loss of muscle strength. In children with SMA type 1, movement is often present in the hip adductors and in each thumb and forefinger.

ALS is a rapidly progressive condition and so people with this diagnosis may require a power wheelchair quickly. A small percentage of people with ALS do have some cognitive involvement which can impact learning new skills. Individual power wheelchair driving methods may not meet the client's needs for long periods of time. Several manufacturers offer a lease program under which driving methods can be exchanged without additional funding approval to address this rapid progression. Movements that often are preserved in this population include eye blink and eye gaze. Available movement for driving method control also varies by the type of ALS. Bulbar involvement results in decreased function of the soft palate. Sip 'n puff pneumatic control requires the client to maintain and regulate air pressure within the mouth. This requires a competent soft palate and so this driving method is often inappropriate for people with ALS.

Clinical Implications

In general, decreased strength results in decreased active range of motion to reach a driving method as well as decreased force to activate a driving method. Endurance is typically low, as well. The client may be able to use a driving method, but not for longer distances or use throughout the day. When selecting a driving method, it is important to consider options with reduced travel and force and that the client can operate throughout their day. As most diagnoses characterized by muscle weakness are progressive, the driving method may have to be changed to accommodate. It is important to anticipate these changes and areas of control that are most likely to be preserved.

Proportional Driving Methods

Proportional driving methods provide 360 degrees of directional control and speed control. The farther the joystick is deflected from center, the faster the power wheelchair moves. Standard joysticks may provide initial control for some people with muscle weakness, however over time this becomes too stiff to move and sustain in a deflected position. Sometimes joystick placement is also an issue. Typically a joystick is mounted at the end of an armpad, but many people with muscle weakness have better control midline and close to the body. Nearly any access method can be positioned where the client has best control.

Mini proportional joysticks require less activation travel and force and so work very well for people with muscle weakness. A standard joystick requires approximately 250 grams of activation force and 28mm of travel whereas a mini joystick may require between 10 and 50 grams of force and 3 – 13mm of travel. As these joysticks are also quite small, it is easier to mount the driving method in a variety of locations. Most people with muscle weakness will use a thumb or finger to activate the mini joystick and providing support to the upper extremity and hand is very important to minimize effort.

Touch pads, using the same technology as a Smartphone screen, are a proportional driving method that require very little force and travel. This access method is typically controlled by a finger or thumb and adequate upper extremity support is again required.

Proportional Programming

Programming directly effects the speed and responsiveness of the power wheelchair. Several programming options are available specifically for proportional control. Sensitivity is how quickly the power wheelchair responds to joystick movement. This is often increased when using a standard joystick to compensate for muscle weakness. Sensitivity may need to be reduced when using a mini proportional joystick, as these are inherently sensitive. Short throw reduces the distance a joystick must to deflected to achieve full speed and is often enabled when using a standard joystick. The throw of a mini proportional joystick is so short already, that this feature needs to be turned off. Other programming features, such as Changing Axes and 3 Direction can be utilized if a client is unable to move any joystick in one of the 4 quadrants of directional control.

Digital Driving Methods

Digital, or non-proportional, driving methods provide directional control in 4 primary quadrants – Forward, Left, Right and Reverse. Speed remains constant and must be changed through other methods, such as changing which Drive or Profile the power wheelchair is in. Digital driving methods use switches and full directional control can be achieved using 1 to 4 switches. Switches can be placed anywhere the client has adequate activation travel and force. A wide array of switches are available, including electronic switches which require no force; significant for this population.

If only one switch site can be identified, the client can drive with single switch scanning using any single mechanical or electrical switch. Driving with only 2 switches to emulate 4 quadrant control is possible through Q-Logic electronics (2 switch), Adaptive Switch Labs (2 switch fiberoptic array) and iDrive electronics (Link). If 3 switch sites can be identified, these are used for Forward, Left and Right. If a 4th switch site is available, this can be used for Reverse or Reset.

Reset is an important tool for clients with muscle weakness. Reset changes the mode of operation of the power wheelchair. Typically, a power wheelchair is in Driving mode and switch activation controls movement of the wheelchair. Activating reset changes the mode of operation so that the driving switches now control other features such as speed, Reverse, power seating, infrared transmission, mouse emulation and control of interfaced devices such as a speech generating device. If a switch site cannot be found for Reset, similar control can be provided through the Standby feature.

Switches can be placed wherever the client has control. Head arrays place switches (typically proximity switches) behind and to either side of the head. Proximity and Fiberoptic switches can also be placed in other locations, including by a thumb or finger. Both of these switch types are electronic, so no force is required. Fiberoptic switches capture the smallest degree of movement. Adequate upper extremity and hand support is critical.

One eye gaze system is available commercially at this time and is designed primarily for use by clients with ALS. A switch activation is required to wake up this integrated system which provides power wheelchair control as well as communication and control of devices in the environment.

Conclusion

People with muscle weakness may require a power wheelchair to provide independent mobility. Driving methods must reduce required activation travel and force to accommodate limited strength. The driving method must be placed where active control is available and will persist as long as possible.

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A6: Clinical Application of the Dispersion Index

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I, Sharon Sonenblum, have received travel support from Ride Designs for this presentation. Other than this travel support, I have no affiliation with any equipment, medical device, or communications organization. I cannot identify any conflict of interest related to this presentation.

I, Tom Hetzel, am the CEO of Ride Designs, a manufacturer of orthotic science based wheelchair and adaptive seating systems for wheelchairs and sports and recreation. Ride Designs is providing financial support to all presenters.

Interface pressure mapping (IPM), is a widely used clinical and research tool in wheelchair seating assessment[1-3]. IPM systems consist of a flexible mat with a number of embedded sensors[4]. IPM systems are becoming more accessible in a variety of clinical and research environments due to their increased availability, reduced cost, and improved ease of use facilitated by enhanced hardware and software systems. These systems are frequently used to help select potentially effective seat cushions to accomplish a variety of clinical goals, including protecting the skin from pressure ulceration.

The origin of IPM system development stems from the role of tissue loading in pressure ulcer (PU) development. Forces acting at the body-seat interface are likely a critical risk factor (among many others) in the risk for developing one of the major complications of chronic wheelchair use – pressure ulcers[5]. Although there are many intrinsic and extrinsic risk factors associated with the development of pressure ulcers, one extrinsic risk factor is external loading of the tissues – particularly those in close proximity to pelvic bony prominences; high risk areas for pressure ulcer development.

Wheelchair seat cushion technologies are designed to protect skin from excessive or ill-placed loading using two primary techniques – offloading and redistribution[6]. Offloading technologies intentionally unload high risk areas (e.g. ischial tuberosities and coccyx) by loading tissues in lower risk areas (e.g. the femurs and posterior-lateral buttocks), thereby providing adequate support to the body while allowing the tissues in various regions of the cushion to experience lower external loads while still supporting the overall body weight[7]. These technologies rely on key principles used in the design of prosthetic and orthotic devices, which intentionally place higher forces in more tolerant regions in order to reduce forces (or eliminate them entirely in some cases) at other, less tolerant, regions[8]. These technologies frequently rely on specific contours and relatively firm materials to achieve the balance between loading and offloading of particular anatomy.

In contrast, cushion technologies that rely on redistribution have a goal to distribute pressure as evenly as possible across the largest contact area possible[9,10]. The main mechanisms involved in accomplishing this are immersion and envelopment[11]. Immersion is the ability of the body to "sink" into the cushion – increasing the contact between the cushion and the body. This is done through a variety of potential design features, including contouring or shaping the cushion to match the contours of the buttocks and using materials that allow the contours of the body to sink, or immerse, into the cushion, creating a custom shape that best matches the body. Envelopment is similar, but its focus is on allowing the cushion materials to move and therefore adapt to the shape and encapsulate the bony prominences of the pelvis. The goal of both of these cushion characteristics is to distribute pressure as evenly as possible (i.e. limit peak pressures and pressure gradients), over the largest contact area possible – which allows an overall reduction in interface pressure in any one area.

The more we understand about the loading at the cushion-buttock interface, the better we may be able to determine the most effective cushion technology for our clients, based on their individual needs. IPM technologies help us visualize the loading that occurs at the buttock-seat interface with various intrinsic technology limitations. They provide us with information that would otherwise not be easily accessible in the clinical or research setting and add to the information available when making clinical decisions about which seat cushion may be most effective for our clients.

There are several interface pressure mapping systems commercially available, including the FSA or Boditrak systems (Vista Medical, Winnipeg, Manitoba,CA), the Xsensor system (Xsensor Technology Corp., Calgary, AB, CA), and the Tekscan system (Tekscan, Boston, MA, USA), among others. IPM systems are manufactured with different sizes and configurations of sensor arrays, placed in thin, flexible mats that can be placed under the seated or supine person. These systems have a combination of hardware and software technologies that allow the system to read and record perpendicular (normal force) pressures between the body and the seat surface. They also provide some processing of the information into various summary metrics.

The reliability and validity of IPM data evaluated in a research laboratory setting have been somewhat suspect[12], due to the limitations of the technologies used and the potential interference of the system with naturally occurring tissue loading (i.e. what would happen in the absence of the mats)[13]. In spite of these limitations, there are potential advantages in the clinic to accessing the information available through interface pressure mapping. IPM systems provide a potential benefit in some instances to the clinical assessment of a limited set of seat cushions and may help a clinician "rule out" a cushion that is not able to provide optimal pressure distributions for a client. Another potential benefit of using an IPM system clinically is for patient and caregiver education. The system provides real time images of the array of pressures under the buttocks, which can provide powerful biofeedback to a wheelchair user re: potential high risk (i.e. high pressure) areas, as well as helping the client and caregiver understand what techniques are most useful when performing pressure relief activities. IPM systems are not able to provide information about what is happening inside the body – i.e. the internal loading that is taking place between the bony prominence and the surrounding tissues. Nor is it adequate to understand what is happening with tissue loading over long periods of time as it offers a "snapshot" of the interface pressure at one point in time or within a small window of time.

Clinical use of IPM systems should follow specific protocols that minimize the occurrence of spurious findings and maximize the potential of the system to provide relevant information to aid in clinical decision making. There are a variety of practical considerations that should be incorporated into this protocol – including providing routine system calibration according to the manufacturer's instructions, making sure the mat is properly aligned on the cushion so that it is able to "capture" the entire sitting area of the person, and ruling out potential sensor errors that might be caused by wrinkles in the mat or faulty sensors. Keeping these practical considerations in mind will minimize the occurrence of inaccurate pressure readings that might mislead a clinician or a client. Additionally, it is important to understand the various metrics available through the IPM systems (e.g. peak pressure, average pressure, regional pressures), and how each of them may help in answering clinical questions.

IPM systems provide two major types of data – qualitative data (i.e. the picture itself), and quantitative data (i.e. individual sensor readings, metrics such as peak or average pressure). Clinicians have naturally tended to interpret the qualitative data - i.e. assess the image that results from the pressure readings, and to use this information in clinical decision making. However, the quantitative data available may be equally powerful in aiding in clinical decision making and in supporting funding of selected cushion.

The first step in the process is to determine what the clinical questions of interest are. For example, if there is a clinical concern about high pressures under specific bony prominences (due to a history or current pressure ulcer perhaps), then looking for high peak pressures in the area of interest will provide the answer. Metrics that will help quantify these high pressures include the PPI or peak pressure index, or a pressure gradient. It is important when high peak pressures are noted in various areas to use a combination of visual analysis and palpation to understand what the root cause might be, particularly if these peaks are not under expected bony prominences. Questions about effectiveness of envelopment or immersion (i.e. effectiveness of redistribution), may be answered by comparing the contact area achieved on various cushions. Redistribution of loads away from specific bony prominences can usually be verified through palpation, however they may also be readily apparent from the visual image (qualitative), as well as from metrics such as the dispersion index. The dispersion index provides quantitative data regarding the percentage of pressure in a specific region of the cushion – such as the pelvic region under the ITs and the coccyx. Symmetry of pressure distribution is another common clinical goal for the application of seating supports. Again, this is relatively easy to qualitatively assess from the image, but can also be quantified by a regional distribution that includes one half of the mat, or through the average pressures or total pressures in each lateral ½ of the mat itself.

Client and caregiver education is another powerful advantage of using IPM systems in clinical environments. Visual representation of interface pressures have a great impact on the ability of clients to understand seating challenges, including high peak pressures, the importance of optimal seating configuration (e.g. optimal foot support height for loading of the femurs and optimal back support configuration for loading of the trunk), and seat cushion set up in the case of adjustable seat cushions, such as those that rely on air inflation. The visual images and quantitative data also help reinforce the necessity of skin inspection – particularly in regions that experience higher pressures in sitting. This visual tool will also help clients understand the impact of posture on pressure and the most effective methodology for weight shifting for intermittent pressure relief.
All of these aspects of interface pressure mapping have potentially powerful impact on the clinical efficacy of seat cushion technologies, many of which rely on specific application and use parameters to function effectively.

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1i: Power Wheelchair Mobility Training for Young Children

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[1]Lisa Placzkowski and Erin Hayes Kelly do not have conflicts of interest to disclose.

Background
Children typically begin standing and walking to explore their environment around one year of age. For children with complex medical conditions that may delay or restrict this milestone, the question of what age a child should receive a powered wheelchair (PWC) remains unanswered. Typically, PWCs are not funded by third party payers until a child is about 5 years-old. However, we know that children can negotiate their environment and understand cause-effect relationships as early as 12-30 months. The primary purpose of this study was to pilot test a PWC training intervention for young children age 12-30 months with neuromuscular disorders. We also sought to explore characteristics of children who were successful in learning basic PWC mobility skills, and determine the number of PWC training sessions needed for children to attain basic driving mobility skills.

Hypothesis
Our hypothesis was that children with neuromuscular disorders who were at least 18 months of age would be successful learning basic PWC driving skills within 16 therapy sessions.

Subjects
Ten non-ambulatory children mean age 20 months (range 12-29 months) with neuromuscular disorders were enrolled. Diagnoses included: spinal cord injury with Down syndrome, cerebral palsy, sacral agenesis, spinal cord injury, arthrogryposis and osteogenesis imperfecta. Eight children completed the training sessions; five as inpatients and three as outpatients as determined by their parent's availability.

Methods
Prior to training a parent of each child completed the Pediatric Inventory of Disability (PEDI) and demographic information was obtained. PWC training was provided in one hour sessions using the skill items described in the Rancho Los Amigos Powered Mobility Program (PMP). Various types of input devices were used; five of the participants used a joystick for steering/control while 3 children used single touch switches/ buttons. The children were seen for 16 PWC training sessions. Inpatients were seen twice a day for two four-day weeks with 16 sessions during that period. Outpatients were seen for two sessions per week for eight weeks. Youth were evaluated using the PMP assessment tool at each session. We operationalized successfully learning basic PWC mobility skills as scoring an average of 3 ("stand-by physical assist with verbal cueing") on the first two sub-sections of the Basic Mobility Skills section: Beginning Skills, Directional Control & Speed Control.

Results

Eight children completed the 16-week training, and four (50%) achieved an average of 3 on the first two sub-sections of the PWC. The four children who successfully learned the skill (achieved a 3) included children who were 14, 19, 23, and 29 months old and they successfully learned the basic skill after their 3rd, 4th, 11th, and 13th sessions. Two of these successful children received the training as inpatients. The four children who did not successfully learn the skill included children who were 12, 14, 14, and 24 months old and three were inpatients. Important to note, two of the children in the "non-achieving" group scored a 2.92, indicating they were very close to attaining these skills. Another child in the "non-achieving" group also had a secondary diagnosis of Down syndrome in addition to spinal cord injury. A visual examination of the data indicated that the children who achieved a score of 3 appeared to be older, and had higher scores on the PEDI at baseline (including the self-care, mobility and social functioning scales).

Discussion

Funding sources often claim that powered mobility is not necessary for young children who are not mobile on their own while research has shown that early independent mobility provides developmental, cognitive and psychosocial gains. Findings from the current pilot study indicate that children who are non-ambulatory or delayed with functional ambulation because of a significant medical condition can learn to use a PWC as a step toward independent mobility.

In 16 sessions, at least half of the children moved from primarily dependent mobility to safely propelling a PWC in a structured environment with minimal to stand-by assist. Children over 14 months of age showed the greatest improvement with the exception of the one child who displayed significant global developmental delay. Six of the eight children completing the study have gone on to obtain a power wheelchair as their primary means of ambulation.

In our experience, powered mobility is often deemed as unnecessary or not worth funding for young children, and this seems to be a cost saving measure on the part of the funding source. However, this can severely and negatively impact the children's developmental maturation and functional independence. It is important for all children to acquire independent mobility as early as possible, particularly to stay in line with the trajectory of typical development. This preliminary work suggests that young children can learn how to operate a PWC. While future research is needed, a PWC may be the most practical form of independent mobility for some children with significant physical disabilities.

Conclusion

This study was able to demonstrate that children as young as 14 months old can successfully learn basic PWC driving skills with several training sessions. It is our hope that this pilot study will fuel interest in further investigation with a larger sample size to address the long term objective of encouraging early independent functional mobility for these children. As of the completion of this study, there has been a surge in the profession in providing simple, home-made mobility devices for very young children due to the efforts of Dr. Cole Galloway and his Go Baby Go team. This approach has helped promote the perspective that mobility is a right and not just a need or want.

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1ii: Predictors of Proficient Power Mobility in Young Children with Severe Motor Impairments

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I, Shelley R. H. Mockler, do not have an affiliation (financial or otherwise) with an equipment, medical device or communications organization. Irene R. McEwen and Maria A. Jones do not have an affiliation (financial or otherwise) with an equipment, medical device or communications organization.

Some young children with motor impairments require only minimal practice to proficiently maneuver power wheelchairs[1,2]. Others require several months of practice to achieve proficiency, however, and some do not achieve proficient mobility even after extensive practice.[3] Research suggests proficiency might be associated with age[4], cognition[5,6], amount of practice[5,7], and practice with a professional rather than a non-professional trainer[7].

Identifying variables associated with proficient power mobility is important for predicting which children are most likely to achieve proficient power mobility and determining optimal intervention approaches to facilitate proficiency. Generalizing the results of previous studies to very young children with severe motor impairments is difficult due to the variability in research approaches and participants. In addition, factors beyond those previously investigated might also be associated with proficiency.

This study explored potential predictors of proficient power mobility in 31 children with severe motor impairments, aged 14 to 30 months at enrollment. An abstract describing the study methods and results is available at http://journals.lww.com/pedpt/Citation/2015/27040/Abstracts__of_Poster_Presentations_at_the_2015.30.aspx

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1iii: Measuring Participation in Daily Life for Children and Youth Using Power Mobility

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We, as a group and represented by Debbie Field as speaker, do not have an affiliation (financial or otherwise) with an equipment, medical device or communications organization.

Learning Objectives
The participant will be able to:

1. illustrate, using at least three examples, how children and youth participate in daily life using power mobility (PM).

2. describe at least four participation dimensions evaluated by three paediatric measures.

3. describe how each of the three measures can be used when evaluating participation of children and youth who use or need PM.

Participation in meaningful life situations, such as playing, learning, being a friend or family member, and engaging in community life are important for all children and youth.[1] Yet, nearly half of Canadians under 15 years with mobility limitations have difficulty participating in everyday activities.[2] Power mobility (PM) devices, typically power wheelchairs, (but also scooters, ride-on toy cars, motorized platforms, or standing devices) are one of several therapeutic mobility options often recommended for those experiencing such difficulties.[3] There is a need to evaluate participation outcomes more systematically to guide assessment, equipment recommendations and outcome measurement of our interventions.[4,5] Describing how children and youth participate in daily life using PM is an important first step.

Purpose
The POWER (Paediatric Participation Outcomes for Wheelchair Evaluation in Rehabilitation) mobility study provided a snapshot of how children and youth who benefit from PM participate in daily life as reported using three different participation measures.

Method
A convenience sample of children and youth who benefit from PM, and their parents were recruited from three regions of British Columbia. This presentation presents cross-sectional data collected at the first time point of a longitudinal study that used an interrupted time series design.[6]

Results
Thirty-two children and parents completed three participation measures in one session with an

assessor experienced in assistive technology provision. Children ranged in age from 5 to 17 years with cerebral palsy being the most common diagnosis.

Parents rated their child's participation across home, school and community settings using the Participation and Environment Measure for Children and Youth (PEM-CY).[7,8] Children's frequency of participation over the last four months in common life situations was rated highest for home participation and lowest for community participation as indicated by frequency percentage possible scores. For those situations their child engaged in, parents rated their child's involvement on average between 'somewhat' to 'very' involved. This level of involvement was similar across all three settings, as was parents' rating of desired change in their child's participation (on average approximately half of the items).

All children were able to rate their own participation in out-of-school leisure pursuits using the Children's Assessment of Participation and Enjoyment (CAPE), although some needed assistance rating intensity over the last four months. [9,10] Overall diversity scores indicated they participated on average in just over 50% of 55 standard items. 'With whom' and 'where' scores suggested that many activities were done at home either alone or with family members. They rated enjoyment on average as 'very much' despite lower intensity ratings.

The Wheelchair Outcome Measure for Young People (WhOM-YP) documented both children's and parents' ratings of importance and satisfaction on individualized, meaningful participation outcomes selected by the child and family.[11-14] Self-identified participation outcomes outside the home were more prevalent than those occurring inside the home. Many outside participation outcomes related to school, although engaging with family and friends in the community was also identified.

Conclusion
Children and youth who use PM are involved in a variety of life situations. The three measures evaluated participation differently. The choice of measurement tool should be based on the desired perspective and specific participation dimensions of interest.

Clinical Significance
Participation outcomes are important for many stakeholders, but especially for children and families.[1] Understanding how participation measures differ in their assessment of children's and youth's participation in daily life will help guide appropriate selection of measurement tools and evaluation of PM interventions.

Acknowledgements
Our research team would like to recognize the contributions of our participants and thank the therapists, educators, administrators and support staff from child development and rehabilitation centres, school districts, medical equipment suppliers and community groups across the province that assisted with recruitment and organization of research sessions.

We would also like to acknowledge the resources provided by the Research Rehabilitation Program at GF Strong Rehabilitation Centre, Sunny Hill Health Centre for Children and the British Columbia Children's Hospital in Vancouver, the Centre for Child Development in Surrey, and the Queen Alexandra Centre for Children's Health in Victoria. This study couldn't have taken place without the effort and commitment of all involved.

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1iv: Sit-To-Stand Wheelchairs and Their Use by Children and Youth with Mobility Limitations: A Case Series

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We, as a group and represented by Debbie Field and Roslyn Livingstone as speakers, do not have an affiliation (financial or otherwise) with an equipment, medical device or communications organization, with the exception of Jaimie Borisoff. Jaimie has had an affiliation with PDG Mobility during the past two calendar years in the role of consulting product manager, manual wheelchairs.

Learning Objectives
The participant will be able to:

1. discuss two reasons why sit-to-stand power wheelchairs may be considered over other power mobility devices.
2. describe three wheelchair performance parameters evaluated by data logger technology.
3. describe three changes in wheelchair use observed in case descriptions of children and youth using sit-to-stand power wheelchairs.

Goals related to standing, along with the use of supported standing assistive technology equipment are often integrated into rehabilitation practices.[1-4] Recent systematic reviews have examined use of supported standing in rehabilitation for children and adults with motor impairments.[5-7] Advances in power mobility technology with sit-to-stand wheelchairs (or standing wheelchairs as they may be known) are increasing options for individuals with motor impairments.[8,9] In addition to providing a means for independent mobility, sit-to-stand wheelchairs provide user-control over body position-in-space from sitting to standing, with the goal of enhancing functional abilities and independence.[9,10] Although this technology is becoming increasingly available, little is known about how children and youth use this technology in daily life.

Data loggers provide a means of objectively measuring human performance in a wide variety of rehabilitation applications.[11] Specific to seating and wheeled mobility research, data loggers measure wheelchair performance parameters such as seating functions used (e.g. tilt, recline, elevation), distance travelled, and bouts of mobility (i.e. segments of continuous movement) in manual and power mobility.[12-14] To our knowledge, only one study has used data loggers to evaluate children and youth's wheelchair use. In that study, children and youth aged 8-17 years had a data logger installed on their wheelchair for one week, Average distance and speed were calculated for both manual and power wheelchair users, along with number of starts/stops per thousand meters.[15]

Purpose
To describe children and youth's use of sit-to-stand power wheelchairs in the first three months post wheelchair delivery, and evaluate changes using data logger technology.

Method

A case series study design evaluated sit-to-stand power wheelchair use for children and youth aged 5-18 years. Data logger technology measured wheelchair use for a one week period over three time-points: at one week, one month and three months post-wheelchair delivery. Evaluation included a pre-wheelchair-delivery time point wherever possible.

Results

Three children (aged 6 and 8 years) and 3 youth (aged 17 and 18 years) participated, four with a diagnosis of cerebral palsy and two with spina bifida. For two individuals, this was their first experience with power mobility. Challenges implementing the technologies because of contextual factors and equipment set-up influenced data collected. Visual analyses of individual case data illustrated changes over time in body orientation as well as distance, speed and bouts of mobility, but this varied across participants. Wheelchair use was influenced by many factors, including personal factors related to individuals' comfort, abilities and motivations, as well as environmental factors such as weather, accessibility, setting contexts, attitudes and behaviours of others.

Conclusion

The use of data loggers provided valuable information about children's and youth's use of sit-to-stand power wheelchairs over time. Sit-to-stand wheelchairs hold promise for increasing children's and youth's independence in mobility and control over body positioning.

Clinical Significance

For those with mobility limitations, sit-to-stand wheelchairs are one mobility option recommended to promote independent control over body positioning and mobility. This is, to our knowledge, the first study to evaluate sit-to-stand power wheelchairs with children and youth and the first to use data logger technology to track changes in wheelchair use over a 3-month period.

Acknowledgements

Our research team would like to recognize the contributions of our participants and thank the therapists, educators, administrators and support staff from child development and rehabilitation centres, school districts, and medical equipment manufacturers and suppliers that assisted with recruitment and organization of research sessions.

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1v: Designing for Dystonia: Begin at the Beginning with Children, Parents and Therapists

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Whole body dystonia is a complex movement disorder that profoundly affects children and their families, in some cases causing whole body involuntary extensor movements that create discomfort and pain, and preventing functional movements such as reaching and grasping. Current seating systems are often inadequate due to their restrictive design.

Previously, we have designed a whole body dynamic seat for children with dystonic cerebral palsy that allows asymmetric movement of the body, while providing good postural support. The seat was used for four years as an every-day school seat by a child in London who has dystonic CP and whole body extensor spasms. Evaluation of this seat showed improvements in functional movements such as hand positioning, head position and vocalization.[1,2]

In our current project, we are designing a seating system for children age two to five years with whole body dystonia. We are also evaluating the feasibility of evaluating the impact of the seat with functional outcome measures suitable for use with this group, as preparation for a subsequent trial with a group of six children. This research is a collaboration of children, parents, paediatricians, therapists and engineers.

Consultation and Design
We are investigating the needs of children and parents through engagement

Parents in the PenCRU Family Faculty are offered opportunities to be involved as partners in research projects. They bring their lived experience and expertise in managing everyday issues for children with disabilities. Parents' time is acknowledged financially and travel expenses are reimbursed. Three consultation meetings have taken place so far:

1. Following a short presentation about the proposed work, discussions amongst three parents identified that the topic was salient to families, and the findings likely to be relevant and useful to their lives. Issues discussed related to acceptable research design for an evaluation of the seating system. For example, the parents did not want to have to do much writing; were keen on the idea of using a tablet computer to document events with video, audio and text; and felt strongly that each child involved in the project should be able to keep their seat at the end of the evaluation period. Involvement of parents at this stage helped persuade the research funders to support this work.

2. In the second meeting, engaging and creative activities were used with six parents and a physiotherapist, to explore the contexts and ways in which a seat would be used.

3. In the third meeting, parents of children and a young adult with disabilities commented on new seating and positioning concepts that were presented to them by the design team.

In the second meeting, the first activity aimed to understand the difficulties young children with whole body dystonia and parents experience akin to describing a 'day in the life'. The facilitator explored their days at home and at preschool step-by-step, discussing each part of the day in turn. In the second activity, participants were provided with images of children using equipment and asked to select a few images that either showed positive or negative aesthetic elements. Although functional considerations were highest priority, aesthetic considerations were important too. Several parents commented that they would like to be able to buy aesthetically coordinated equipment with, for example, matching changing bags. Some of the more experienced parents commented that they started their journeys as parents expecting to be able to buy beautiful equipment like all the others parents, but as time went on, they lowered their expectations and became satisfied with what functional equipment they could obtain.

Feedback from parents suggested strongly they enjoyed being consulted as experts in their lives. Involving parents as meaningful partners in the research is informing and improving the quality of the research, having positive impact on parents and researchers. Further meetings and engagement with parents and children with dystonia are planned at key stages in the design process.

The team also engaged with five families with a child age two to five years with dystonic cerebral palsy. They discussed the parents' approach to providing support for their children, explored the range of their daily activities, and evaluated alternative positions for functionality and comfort. It was important to the parents that their children were able to play and engage in at table height and at floor level. Using coordinated manual support schemes provided by the team and the child's parent, we explored the support necessary for dynamically positioning and supporting children in upright neutral sitting (perching), side-lying and prone positions[3].

At the time of writing, the project team is designing a new seat prototype for rapid evaluation of the proposed concepts with the children in the evaluation group. A sketches of the concept is shown below. Following the consultation and evaluation work, key features of the new seat are, in no particular order:

1. The new seat should accommodate a wide range of voluntary and involuntary asymmetric movements made by children with dystonic cerebral palsy, while providing the postural support they require to function.

2. The aesthetic appeal of the seat was important to the parents.

3. It should facilitate upright seated activities, as well as play at floor level; with easy transitions between positions.

4. The seat should be easy to clean, without crevices and holes where food, saliva and other body fluids can be trapped.

5. The seat should have a tray for toys and other activities.

6. The seat should be light-weight and dismantle into convenient pieces, for easy transport in a modest sized car.

7. Transfers into and out of the seat should be quick and easy, and able to be done by one person. It should be noted that this requirement is for a seat for preschool children, and not older children.

8. The seat should be quick and easy to adjust for position and fit.

Outcome Measure Feasibility
The second strand of this project is to evaluate the feasibility of using a range of functional outcome measures with children aged two to five years who have dystonic cerebral palsy. These are a delightful, but challenging group of children with work with scientifically, as they are usually non-verbal, and have not yet usually learned to use word books or other communication aids that would enable communication of more complex ideas. They are also easily distracted, have relatively short attention spans, and are not tolerant of prolonged handling.

Our aim is to check the feasibility of using measures that will allow us to assess the impact of using the new seat on the functioning of the children in communication, physical function and social engagement. We want to use measures that, where possible, are directly measured from the child, and only use proxy measures where necessary. We are currently evaluating the following measures and assessments for suitability for use with this group:

1. For initial classification: Gross Motor Function Classification System (GMFCS)[4], the Communication Function Classification System (CFCS)[5] and the Manual Ability Classification System (MACS)[6].

2. Communication and interaction: Parental report, event based statistical video analysis, Vineland 2[7] and the Keys to Interactive Parenting Scale (KIPS).

3. For hand function: Parental report, Performance Quality Rating Scale (PQRS)[8]personally meaningful activities. It has been used inconsistently with different scoring systems, and there have been no formal publications on its psychometric properties. The purpose of this study was to test and compare the psychometric properties of two PQRS scoring systems in two populations. Methods: A secondary analysis of video recorded participant-selected activities from previous studies involving either adults living with stroke or children diagnosed with developmental coordination disorder (DCD, A sensor based assessment of a standardised task, event based statistical video analysis.

4. Quality of life: Parental report, a new version of the Child Health Utility 9D (CHU9D) designed for preschool children and Pediatric Quality of Life Inventory (PEDS-QL)[9]Second Edition (Vineland-II.

5. Goal based assessment: PQRS and the Canadian Occupational Performance Measure (COPM)[10] to assess goals set with the children and their parents.

We will not be using all these measures in the trial following this research. The purpose of this feasibility study is to determine which measures can practically be used with this population.

Conclusions

Direct engagement with parents and children in the design process has yielded valuable insight into their needs and desired for seating. Facilitating function was the highest priority design consideration, however close behind this were considerations of practicality (ease of use, weight, cleanability, etc) and aesthetics (colour, finish, design, accessories). Parents often change the position and location of their children, who live and play in different contexts within the home, nursery and local community. Coordinated manual dynamic support has enabled initial testing of a variety of support schemes, informing the design of a new seating system.

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2i: Impact of Transfer Training Among Full Time Pediatric Wheelchair Users

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Background

The ability to effectively transfer is essential for the performance of both basic and instrumental activities of daily living for individuals who utilize a wheelchair (WC) full time.[1] A typical manual wheelchair user will perform between 14-18 transfer per day[2] in order to do necessary activities such as getting out of bed, taking a shower and getting into a car. In a survey of full time wheelchair users, 4 of the 10 most important wheelchair related skills were associated with transfers[3].

As a result of their importance and frequent performance, transfers must be performed correctly to prevent the development of upper extremity pain and dysfunction[4]. Among adult wheelchair users, transfers are a frequent cause of upper extremity pain[4] and often described as one of the most demanding wheelchair related activities.[5] During daily transfers, the upper limbs are exposed to high forces and moments repeatedly. The shoulder joint however is designed for mobility, not stability and these increased demands may predispose individuals to injury .[6] Thus, high levels of repetitive force often lead to structural degeneration and pain.[6]

While adult WC users often receive formal training, transfer training among pediatric WC users is limited[7]. Pediatric WC users often have to “figure it out” on their own and thus do not learn the proper techniques. Acquisition of such an important skill through a trial and error method however, is likely to have a detrimental impact. Previous research has shown that utilizing optimal techniques during a transfer can significantly decrease the magnitude of force placed on the upper extremity[8] and help preserve upper limb function over the long term. Therefore, the purpose of this study is to investigate the impact of a transfer-training program designed for pediatric WC users.

Methods

A volunteer sample of twelve (n = 12) of pediatric WC users between the ages of 8-18 who self-reported full time, independent manual WC use and at least 2 years post onset of disability were recruited to participate. After informed consent/asent was obtained from participants and parents/guardians, 7 participants were randomized into an intervention (IG) and 5 to a control group (CG). All participants were asked to perform up to four level transfers to and from their WC to a padded bench with their preferred technique. Transfer quality was measured by the Transfer Assessment Instrument (TAI)[9]. The TAI is designed to evaluate the quality of a transfer and the consistency of performance, not how much assistance is needed. Participants receive a final score between 0-10 in which 0 indicates poor quality and 10 indicates high quality.[10] After completion of baseline testing, all participants were given a 10 minute rest and then asked to perform two more sets of the same transfers to assure they were adequately accommodated to transferring to the target surface. No feedback or training was given to participants prior to or during the first two assessments.

After completing 2 sets of transfers, IG participants were then instructed on transfer skills by a Physical Therapist utilizing an instructional video. The video described the important components associated with transfers including proper upper extremity placement, body positioning, conservation techniques, movement strategies and hand placement. A multi-disciplinary team of researchers, clinicians and wheelchair users developed the video. Participants had the opportunity to practice transfers and receive immediate feedback on performance. The CG was given a 20-minute rest break. After the training or the rest break, all participants were asked to perform 4 additional transfers.

Results

Participants were 15.69 (SD ± 1.44) years old (range 13-18 years) with 10.77 (SD ± 3.83) years of wheelchair use. The most common type of disability represented was Spina Bifida impacting 41.7% (n = 5) of participants. Other disabilities represented include: s/p amputations (n=2), cerebral palsy (n = 1), spinal cord injury (n = 3) and Charcot-Marie-Tooth n = 1). No significant differences were seen among study group at baseline based on demographics or transfer skills. Mann-Whitney tests were performed to examine differences in transfer performance after exposure to an educational program. Results indicate that after exposure to the intervention, participants in the IG (mean = 9.06, SD = 1.01) had significantly higher scores compared to the CG (mean = 7.15, SD = 1.68), $p = 0.030$, $d = 1.385$.

Discussion/Conclusion

The purpose of this study was to describe a basic but structured education program designed to educate pediatric wheelchair users on transfer skills and examine the preliminary feasibility of the education program. Results indicate that the training program was well-tolerated by participants despite the repetitive process. After exposure to the program, transfer performance improved significantly. Short term improvements are encouraging and may be a factor in long term upper extremity preservation. The results of this study however are limited as only the immediate impact of the education was observed. In addition, the small sample size limits the generalizability of the results to a larger group of pediatric wheelchair users. Further testing is needed to examine the long-term impact of the education program with a larger group of wheelchair users.This preliminary work will serve as important basis in the development of evidenced-based transfer training programs that can be used both clinically and independently by pediatric wheelchair users.

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2ii: Does Wheelchair Configuration Make a Difference In Wheelchair Skills? Translating Research into Function

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We, Jessica Presperin Pedersen, Mary Shea, Rachel Cowan, and R. Lee Kirby do not have an affiliation (financial or otherwise) with an equipment, medical device, or communications organization.

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Background
There are very few studies that document the effectiveness of group or individual wheelchair skills training. During the baseline for the wheelchair skills training aim, data was compiled pertaining to the configuration of the wheelchair. The participant's ability to perform and feel confident about various wheelchair skills was also collected from each participant. This baseline information is the data being analyzed relative to their wheelchair skills capacity and performance in this paper presentation.

Objectives
To assess baseline data of wheelchair skill capacity and wheelchair skill performance and confidence to determine if wheelchair configuration makes a difference

Design Cross-sectional descriptive study

Method

Data Collection
COMIT is a randomized-waitlisted, experimental study being conducted at four SCI Model System Centers. One of the aims of the grant is to assess the effectiveness of group wheelchair skills training. During the baseline for the wheelchair skills training aim, data is compiled pertaining to the set-up of the wheelchair. The participant's ability to perform and feel confident about various wheelchair skills is also collected from each participant. This baseline information is the data being analyzed and discussed in this paper presentation.

Participants
Using a sample of convenience driven by a power analyses for the parent study there were 176 manual wheelchair users with spinal cord injury between the ages of 18-75, using a manual

wheelchair greater than 50% as a primary means of mobility, live in the community, and had a Mini-Mental State Examination (MMSE) score of $\geq$ 23.

Settings
University of Pittsburg Model Center on Spinal Cord Injury, South Florida Spinal Cord Injury Model System -University of Miami, Northern New Jersey Spinal Cord Injury System -Kessler Institute for Rehabilitation, Midwest Regional Spinal Cord Injury Care System - Rehabilitation Institute of Chicago.

Data Collected at Baseline

- SCI level Paraplegia (C8 and higher) Tetraplegia (below C8), gender, height weight
- Age of wheelchair
- Wheelchair set up
    - » Arm support (yes/no)
    - » Angle of elbow when hand is at top of wheel rim
        - < 100
        - 100-120 CPG recommended angle
        - >120
    - » Axle position relative to shoulder
    - » Wheel camber
    - » Seat inclination (degree based on inclinometer)
    - » Seat to back support angle (degree based on inclinometer)
    - » Back support height
    - » Front to floor seat height
- Wheelchair Skill Test Questionnaire Version 4.2
    - » 32 skills
        - 11 indoor
        - 11 community
        - 10 advanced skills
    - » For each skill- capacity score “can you do this skill”
        - Yes
        - Yes with difficulty
        - No
    - » For each skill- how often in daily life
        - 1x day
        - Weekly
        - Monthly
        - Yearly
-

- Wheelchair Use Confidence Scale (WheelCon) measures participant's belief in his/her ability to perform each item independently
  - » Not at all confident
  - » Mostly confident
  - » Somewhat confident
  - » Mostly confident
  - » Completely confident

Results/Discussion
Individuals who use armrests tended to score lower on advanced and total wheelchair skill capacity and performance scores and reported lower confidence with using ultra-light wheelchair.

Individuals who had an elbow angle between 100-120 degrees tended to score higher on advanced and total wheelchair skills capacity and performance. This is consistent with the recommendations in the Clinical Practice Guidelines for Upper Limb Preservation for Individuals with Spinal Cord Injury.

Individuals who had a more anterior axle position scored higher on advanced and total wheelchair skills capacity and performance. This is also consistent with the recommendations in the Clinical Practice Guidelines for Upper Limb Preservation for Individuals with Spinal Cord Injury.

Individuals with a higher degree of camber greater than or equal to 5 degrees trended towards higher advanced performance skills with capacity than individuals with 0-2 degrees of camber.

Individuals with higher front seat to floor height measurements demonstrated greater total and advanced wheelchair skills capacity and performance than people with lower front seat to floor height measurement. We felt that this could be a gender effect due to the male population being taller than women and therefore being seated in a wheelchair with a higher seat to floor height. If we had additional information on the client's body arthrometrics, it would further clarify this finding.

We did not note any trends in wheelchair skill capacity or performance relative to back support height.

Limitations/Future Studies
We were able to determine several correlations between wheelchair set up and performance of wheelchair skills. We felt that additional information for baseline measurements specifically the wheelchair configuration relative to the client's body physique would be helpful in the future. We also feel that feel we could make stronger correlations with wheelchair set up and wheelchair skills capacity and performance if the wheelchair configuration was changed to see how different wheelchair configurations impacted wheelchair capacity and performance scores.

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This paper presentation is based on our findings analyzed by Rachel Cowan. She presented this in the 2015 American Congress of Rehabilitation Medicine Annual Conference in Toronto and we have a publication that is in review titled: Differences in Manual Wheelchair Skills and Confidence.

2iii: Effects of Different Backrests on the Performance During Manual Wheelchair Propulsion: An exploratory study

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Introduction
Manual wheelchair users with a spinal cord injury frequently present sensorimotor trunk impairments which limit their trunk stability/control ability and affect their manual wheelchair propulsion performance and ability. Different types of backrests have been commercialized over the past years to overcome these limits during manual wheelchair propulsion. The wide range of available backrests and the lack of sophisticated decisional rules makes it challenging to select the most appropriate backrest for a given manual wheelchair user. In this context, it is no surprise that many consultations in wheelchair clinics will lead to the selection of a backrest that will optimize body alignment and postural stability while simultaneously maximizing performance. This decision making process remains an iterative process based on clinical experiences, intuitions, trials and errors, and adjustments as well as on the interactions between therapists and users since very little evidence is available.

Objective and hypotheses
The objective of this study was to quantify and compare the effects of four different types of frequently used manual wheelchair backrests (tension adjustable backrest, jay 3 backrest, Jay3 backrest adjustable thoracic supports, and the Harmoni backrest) on manual wheelchair propulsion performance and perceived level of comfort, stability and overall performance. The hypothesis was that a rigid manual wheelchair backrest, particularly those with lateral thoracic supports would optimize the performance and perceived comfort, stability and overall performance as they optimize trunk stability.

Methods
A sample of ten experienced manual wheelchair users (gender=8 males/ 2 females; age=44.4±13.5 years; weight=75.4± 25.3 kg; height=170.5± 0.8 cm) with a complete or incomplete spinal cord injury (range: C7 to T12) were recruited through the wheelchair clinic program of IRGLM. Potential manual wheelchair users who had a history of cardiorespiratory disease, clinical evidence of secondary musculoskeletal impairments involving the trunk or upper extremities – for example shoulder pain assessed with the Wheelchair User Shoulder Pain Index [2,3], or any other conditions limiting their ability to perform the manual wheelchair slalom test (MWST) [4] were excluded. Ethical approval was obtained from the Research Ethics Committee of the Centre for

Interdisciplinary Research in Rehabilitation. Participants reviewed and signed an informed consent form before entering the study. Participants attended a single evaluation session completed at the Pathokinesiology Laboratory of the Centre for Interdisciplinary Research in Rehabilitation (CRIR) located at the Institut de réadaptation Gingras-Lindsay-de-Montréal (IRGLM).

Following a clinical evaluation, participants tested four different backrests in a random order during performance-based wheelchair tests: tension adjustable backrest, Jay 3 backrest, Jay3 backrest adjustable thoracic supports, and the Harmoni backrest. The tension adjustable backrest is a soft backrest with adjustable sling integrated at the back, allowing to adjust the support all along the user's back. The Jay 3 backrest is a profiled rigid backrest with a comfort cushioning. The Jay 3 backrest with thoracic supports is the same backrest as the Jay 3 on which we added rigid adjustable thoracic supports. Finally, the Harmoni backrest is a soft, tension adjustable backrest, with integrated thoracic supports fixed on the upholstery , and with a lumbar sling allowing about 5 cm of lumbar support as it passes through the rigid thoracic parts, about 2 centimeters forward of the wheelchair's upholstery. Once a specific backrest was installed and adjusted at the right angle and height, their effects were tested while performing the following tests in a random order: 20-meter propulsion test and the manual wheelchair slalom test. For the 20-meter propulsion test, Participants were instructed to propel their wheelchair at both a self-selected natural velocity ($MWPT_{20m\text{-}NAT}$) and at a self-selected maximal velocity ($MWPT_{20m\text{-}MAX}$) from a specific start line until they crossed a finish line set 20 meters further down the corridor. For the Manual Wheelchair Slalom Test (MWST)[4], participants were instructed to propel their wheelchair at a self-selected maximum velocity along a slalom trajectory (linear length=18 m). It is defined around 7 heavy, bright-colored cones with flags mounted on a 1.5-m pole, aligned in a straight line and set 3, 2 and 1m apart from one another. To familiarize themselves with the MWST test, participants completed the trajectory once at a slow pace before starting the test. For all tests, the averaged time required to complete the two trials, expressed in seconds, was calculated. All tests are safe, reliable and accurate performance-based outcome measure[4]. To prevent fatigue, participants were allowed a 2-minute rest period between each trial, a 4-minutes rest period between each test and a 10-minute rest period between each backrest. After completing the test for each backrest, the participants were asked to quantify their perceived level of comfort, stability and overall performance using the 10-point visual analog scale. Before starting the performance-based wheelchair tests, the mechanical condition of each participant's wheelchair was verified and adjusted accordingly since they propelled their own wheelchair and the size of the backrests (i.e., width and height) was selected based on their anthropometric measurement. The rear wheels of each participant's wheelchair were replaced with instrumented handrims (Smartwheel [tm]) to collect spatiotemporal (i.e., push and recovery times; velocity) and handrim kinetics (i.e., total force, tangential force, and mechanical efficiency) during the performance of the wheelchair tests [6,7,8].

Descriptive statistics were calculated for the demographic and clinical characteristics as well as for the main outcome measures (i.e., spatio-temporal, handrim kinetics, and perceived level of comfort, stability and overall performance). Freidman tests were used to verify if the use of the four different backrests tested had a significant effect on the main outcome measures. The significance level was set at 0.05 for all statistical tests. All statistical analyses were performed with SPSS statistic software version 17.0.

Results and discussion

A similar amount of time (13.9-14.8s) was needed to complete the $MWPT_{20m\text{-}NAT}$ across the four backrests tested, respectively. In fact, during the push phase, participants were propelling their wheelchair at similar velocity when using any one of the four backrests tested (1.47-1.61 m/s). The duration of the push (0.29-0.32s) and recovery (0.52-0.59s) phases was similar cross the four backrests tested, respectively. The mean and maximal F_{TOT} (mean: 37.2-39.7Nm; max=71.2-78.3Nm) and F_{TANG} (mean:25.7-27.7Nm ; max=55.5-59.4Nm) applied on the handrim were similar across the four backrests tested, respectively. The mean MEF was also similar (39.3-40.0%) across the four backrests tested. A similar amount of time was needed to complete the $MWPT_{20m\text{-}MAX}$ (8.9-9.1s) and the wheelchair slalom test (16.0-16.4s) when using any one of the four backrests tested, respectively. Hence, the type of backrest had no significant effect on the spatiotemporal and handrim kinetics measures.

Similar perceived levels of comfort (3.8-6.4/10), trunk stability provided (4.6-6.4) and overall performance (4.1-6.1/10) were documented across the four backrests tested. Participants predominantly expressed a preference for the tension adjustable backrest (n=3), the Jay 3 backrest without thoracic supports (n=4) and the Harmony backrest (n=3). The occupational therapists selected the same backrest upon the performance of the different tests for the majority of participants (n=9/10). The selection of a backrest is moderately influenced by the comfort, trunk stability and overall performance provided.

Conclusion

The four different types of backrests tested in this study were found to have no significant effect on the spatiotemporal and handrim kinetic outcome measures as well as on the perceived levels of comfort, trunk stability and overall performance during manual wheelchair propulsion. Hence, recommending the best backrest remains a complex process being influenced by many factors and requires personalized assessment and recommendations made by a rehabilitation professionals. Further research is required to explore additional factors and their interactions.

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2iv: Training Considerations in Using a SmartDrive™

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Introduction

The SmartDrive™ is a relatively new power mobility add-on for manual wheelchairs, which is significantly lighter than other add-on devices (e.g., pushrim activated powered assist wheels) and uses an alternative means of activation. Although, there have several models that have been produced, they share a number of common attributes. First, additional propulsive force is provided to the manual wheelchair via a drive wheel that is mounted underneath the wheelchair to either the rear axle of bar connecting the two wheels. The drive wheel is engaged when the user applies sufficient acceleration force via the handrims. Second, the device has two modes of operation. In the indoor mode, the SmartDrive™ is deactivated by grabbing the wheelchairs handrims. This deceleration force turns off the drive wheel. However, in bumping terrain this means the drive wheel cuts out frequently. In the outdoor mode, SmartDrive™ can only be deactivated by triggering a switch, at which point the handrims may be used to stop the wheelchair. Because stopping in the outdoor mode requires users to alter habitual propulsion patterns, however, it may be challenging for some users.

Training programs exist to teach wheelchair skills,[1-5] but few studies have explored training issues associated with the introduction of powered add-on devices such as the SmartDrive™. Furthermore, we are unaware of any published research on the outcomes associated with SmartDrive™ use.

Therefore, we initiated a study with two main objectives:

1. To determine how much training wheelchair users perceive is required to learn how to use a SmartDrive™ safely and confidently.

2. To assess how the SmartDrive™ impacted wheelchair users' wheelchair skills capacity, wheelchair mobility confidence, and ability to negotiate an obstacle course.

Methods

The study used a pre-post, crossover design in which participants were assessed with and without the SmartDrive™ following the provision of a series of thirty-minute training sessions. Participants selected the number of training sessions they felt were required for them to able to use the SmartDrive™ safely and confidently.

Main Outcome Measures

Training time was determined based on the number of sessions participants requested. Wheelchair mobility confidence was measured using the physical environment sub-scale of the Wheelchair Use Confidence Scale.[6] Wheelchair skill capacity was assessed using an abridged form of the Wheelchair skills test 4.2[3] (omitting items unrelated to the SmartDrive™ such as reaching and transferring). The obstacle course included six tasks: 1) getting into and out of an elevator, 2) crossing a street at a zebra crosswalk, 3) wheeling downhill on a sidewalk approximately 50 meters, 4) wheeling up a grass hillside approximately 10 meters), 4) wheeling uphill along a paved walkway approximately 10 meters, 5) wheeling over a relatively level, fine gravel footpath approximately 5 meters) and wheeling up a 200 meter concrete ramp (5% grade). The latter five tasks were timed.

Analysis

Paired t-tests were performed to compare outcome measure scores before (without SmartDrive™) and after the first 30 minute training session (with SmartDrive™)

Results

Participants: Eleven manual wheelchair users, with an average age of 40 years, were enrolled in the study. Six were male. All had prior wheelchair skills training and used ultra-light wheelchairs.

Two participants requested a second training session. However, several potential safety concerns were noted. (e.g., some participants had difficulty in the outdoor driving mode. No significant changes were noted in wheelchair use confidence post provision. The SmartDrive™ did not significantly affect participants' average wheelchair skill capacity as measured by the Wheelchair Skill test. However, two participants were only able to perform the 10^{o} incline with the SmartDrive™. Participants performed two obstacle course tasks more quickly with the SmartDriveTM (i.e., the 200 m incline and paved walkway uphill. One participant could only negotiate the gravel, rough gravel, zebra crossing and 200 m ramp with the SmartDrive™.

Conclusion

Although participants indicated they felt safe and confident using the SmartDrive™ after only one or two training sessions, potentially users likely require more practice to learn how to use the device safely, especially in the outdoor mode. The SmartDrive™ had some obvious potential benefits, in terms of increased speed, no negative effect on the ability to perform wheelies (unlike pushrim activated power assist wheels[1] and allowing some users to negotiate obstacles they would otherwise be unable to perform. Further research is needed to develop training strategies to teach users how to brake in the outdoor mode and to study longer-term outcomes.

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2v: Experienced Fatigue, Pain and Instability During Sitting in Persons with Chronic Spinal Cord Injury

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I, Linda Valent do not have any affiliation with financial or otherwise, with an equipment, medical device or communication organization.

Introduction

Persons with a Spinal Cord Injury (SCI) who lack walking ability, generally spend many hours in the wheelchair every day. Depending on the age at onset of SCI, this may be the case for many years. People generally posses only one hand rim wheelchair with one cushion and consequently the ergonomically adjusted wheelchair determines the way they sit during most of the time.
It is important to be aware of the unnatural situation of one predominant sitting posture in the wheelchair, especially in a disturbed body with SCI.

As a consequence of the primary impairments, e.g. paralysis, lack of sensation, muscle atrophy, spasms and disturbed blood supply to the buttocks[1], people with a SCI seem to be relatively prone to develop seating-related health problems. Commonly reported health problems are pressure sores[2] 00000" w:usb3="00000000" w:csb0="0000019F" w:csb1="0, spinal deformities[3], respiratory complaints, (lower) back pain[3,4], chronic musculoskeletal pain, and fatigue. These health problems are known to have a large impact on physical activity[5], participation[6] and quality of life[7,8]. Moreover, with ageing, people with SCI seem to experience more of these complaints, which are also reported more often than in the normative population.[9] Complaints such as mentioned above may be a direct consequence of the spinal cord lesion, however, they may also be caused, aggravated or sustained by an improper sitting posture and/or prolonged seating.

In wheelchair bound persons with a SCI, therefore, a comfortable – i.e. pain free and not fatiguing – stable and safe sitting posture is an important prerequisite for optimal functioning in daily life[10].
To our knowledge, literature on seating in SCI is still scarce[11] and the current study is the first to investigate the prevalence of satisfaction with seating as well as perceived seating-related problems in a large cohort of persons with chronic SCI. The aims of the current cross-sectional study among the Dutch chronic SCI-population are to describe:

1. the prevalence and severity of perceived seating-related health problems
   e.g. pain, fatigue, instability in persons with chronic SCI

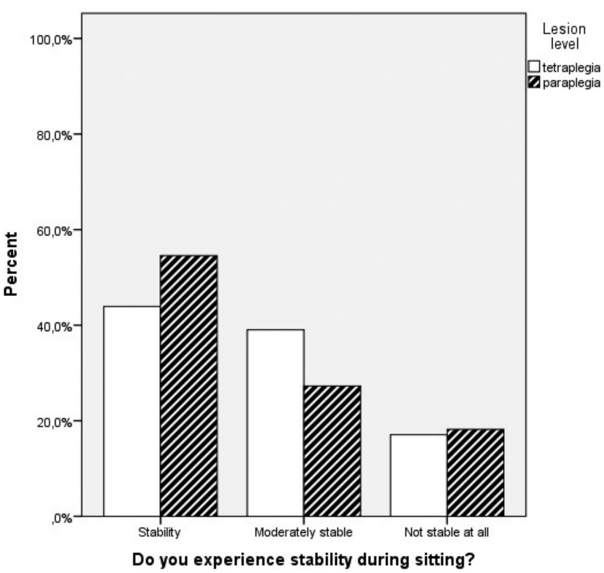
2. reported (dis)satisfaction with seating posture in the wheelchair

Methods

A cross-sectional study among 265 persons ≥10 years after SCI who use a wheelchair for daily mobility. Satisfaction with seating and seating-related problems were measured using a self-report questionnaire.

Results
Of all subjects, 84.4% reported sitting to be fatiguing (sometimes: 51.1%; regularly - always: 33.3%) and 70.5% indicated having pain while sitting (sometimes: 42.4%; regularly - always: 28.1%). Most reported pain locations were the lower back, back at shoulder height, neck, and ischial tuberosity.

Sitting stable, reasonably stable, and not stable at all in the wheelchair is reported by 55.1%, 36.6%, and 8.3% respectively. During an activity (e.g. reaching for a bottle in paraplegia or for a cup in tetraplegia) 29% experienced instability (falling aside and/or to the front). A small selection of our results is shown in figure1 with clear differences in experienced stability between paraplegia and tetraplegia. The majority of all subjects (58.1%) was satisfied with their sitting posture, another 27.5% were reasonably satisfied. Although only 14.4% were dissatisfied with their sitting posture, 57.9% of all subjects indicated that their sitting posture could be improved.



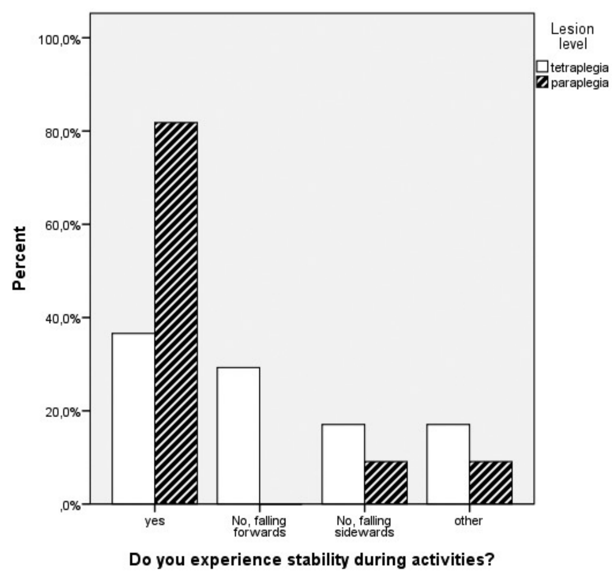


Fig 1a and b: Results on experienced stability in paraplegia and tetraplegia.

Conclusions
Persons with SCI frequently report fatigue, pain and instability during sitting. Although these problems might be caused by more factors than sitting alone, a vast majority believes their sitting posture can be improved. An optimal sitting posture probably means more comfort (less pain and fatigue) and stability. Persons with SCI should be advised to have their sitting posture regularly checked, preferably by SCI-specialized seating therapists.

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3i: Does 'Goal Satisfaction' Improve with Personalized Power Wheelchair Skills Training?

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Literature Review
The number of power mobility users is likely to increase with the coinciding aging population. Power mobility devices enable many Canadians to have independent mobility and more fully participate in their lives. A systematic review found evidence that power mobility devices improve activity and participation[1]. Additional studies have identified other important benefits of power mobility including self-esteem[2] and social participation[3].

The World Health Organization (WHO) has identified that 'user training' is a required step in the wheelchair provision service-delivery model[4]. However, many individuals who use manual wheelchairs receive little to no skills training and therefore may not use their wheelchair safely or effectively[5]. Although many Canadians do not receive formal wheelchair skills training, it has been found to improve manual wheelchair-related confidence among aging adults[6].

Personalized goal setting allows individuals to focus on goals that are important to their daily lives and incorporates autonomy into the training process. No research has explored whether personalized training based on the Wheelchair Skills Training Program (WSTP)[7] improves power mobility goal satisfaction.

Purpose
The purpose of this study was to report on the power mobility goals of 17 individuals who participated in a personalized power wheelchair skills training intervention and to determine changes in goal satisfaction immediately following training and 3-months post training.

Methods
This sub-analysis of a larger data set from a multi-site randomized controlled trial[8] consisted of participants randomly allocated to the 'power wheelchair skills training intervention' group from Vancouver and Quebec City. Inclusion criteria for participation in the study consisted of being 18 yrs or older, having a mobility disability requiring the use of a power wheelchair, having access to a power wheelchair, and using the power wheelchair for at least 4 hrs/ week. Exclusion criteria included having a rapidly progressive disorder, visual impairments, or unstable medical conditions.

Participants were asked how they rated their current satisfaction (on a scale of 0-10, 10 being the most satisfied) with each goal that they set prior to training for that specific goal. Satisfaction with each goal was recorded upon completion of training and again 3-months post training. The power wheelchair skills training consisted of five 30-min one-on-one training sessions that followed the WSTP.

A repeated measures one-way ANOVA controlling for months of power wheelchair experience was used to determine differences in satisfaction at three time points including: (1) prior to training-baseline, (2) immediately following training, and (3) approximately 3-months post training.

Results
Seventeen participants (12 Van, 5 QC) who were randomly assigned to the WSTP intervention in the larger randomized controlled trial[8] were included in this sub analysis. The 17 participants were 54.1±12.8 (mean±SD) yrs of age (range=26-81 yrs) and had 5.6±5.3 yrs of experience (range=0.25-15.5 yrs) using a powered wheelchair.

Ninety power mobility-related goals were set among the participants with an average of 5.3±1.5 goals per person. Goals fit into the following broad categories: maneuvering (n=25); backing up (n=14); hills (n=6); transferring (n=3); potholes/ gaps (n=10); terrain (n=8); curbs (n=11); cross slopes (n=3); and other (n=7).

Upon setting goals, participants rated their average goal satisfaction as 4.7±1.9, after training participants rated their average goal satisfaction as 8.0±1.0, and 3-months post training participants rated their average goal satisfaction as 8.3±1.2. Controlling for months of PWC experience, participants improved their goal satisfaction immediately following training ($p<0.001$, $\eta_p^2=0.55$). Goal satisfaction was maintained at 3-months post training (there was no statistically significant difference in goal satisfaction immediately following and 3-months post training) ($p=0.871$) in 76% of the goals set.

Discussion
Satisfaction with personalized goals improved immediately following and was maintained at three-months post the WSTP intervention, compared to baseline scores. Interestingly, out of the 90 mobility-related goals set, the majority (n=25) focused on the foundational skill of maneuvering even though participants had upwards of 15 years of experience. The larger (n=116) multi-site Canada-wide randomized controlled trial did not identify improvement in wheelchair skills capacity three-months post power wheelchair skills training, however, they did identify some improvements immediately following skills training in the Wheelchair Skills Test- questionnaire (WST-Q) performance scores and the mean ± SD Goal Attainment Score (GAS) for the intervention group rose from 0 pre-training to 92.8%±11.4% after training and overall satisfaction with training was high[8]. Our sub-analysis identified that participants reported greater satisfaction with their goals in keeping with the improvement in GAS scores.

It is possible that satisfaction with goals may not be related to the WST-Q performance or capacity scores. The personalized goals set may not directly correspond with specific mobility-related skills in the WST. For example, one participant selected ‘sweeping’ as a personalized goal. There are components of sweeping that could be broken down into skills identified on the WST, however the overall success may not translate into individual skill components. Alternatively, someone may have mastery over the individual skill components, but may not have previously been successful in integrating the skill components together, therefore the WST-Q would not be expected to change, but the goal satisfaction would likely improve.

Conclusion
Personalized power mobility skills training improved goal satisfaction among power wheelchair users from two Canadian cities immediately following and 3-months post training.

Clinical Application/ Take home message
Improvements in self-selected mobility goal satisfaction were retained following personalized one-on-one PWST. Therefore, individualized goal satisfaction should be considered because it may provide insight into how the client perceives their mobility-related goals.

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3ii: Air-Cell-Based Cushions Protect Seated Bariatric/Diabetic Patients: Computer Simulation Studies

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I Kara Kopplin have/had an affiliation (financial or otherwise) with an equipment, medical device or communications organization during the past two calendar years. I am employed as the Senior Director of Efficacy and Research for ROHO, Inc, a business unit of Permobil, and I have responsibilities for leading the research efforts of the family of companies. Dr. Gefen is the Chair of the Scientific Advisory Board of ROHO, and his laboratory at Tel Aviv University received research funding from ROHO, Inc., for analyzing the effects of cushioning materials and designs on buttocks tissues during weight bearing. We, the authors, disclose that this support is, however, irrelevant to the data presented and the conclusions made here.

Introduction
This study has been peer reviewed and at the time of writing has been accepted for publication in the January 2016 issue of Ostomy Wound Management:

Levy A, Kopplin K, Gefen, A. "A Computer Modeling Study to Evaluate the Potential Effect of Air Cell-Based Cushions on the Tissues of Bariatric and Diabetic Patients." *Ostomy/wound management* (January) 2016.

The following extended abstract summarizes the highlights from the above article. For a complete, detailed description of the study, the reader is referred to our above paper.

Purpose
The past decade of research has clearly established that severe pressure ulcers, including specifically deep tissue injury, are primarily caused by the effects of sustained deformations over critical time periods. These deformations can quickly disrupt the homeostasis of the distorted cells and viability of the deformed tissues in relatively short time frames, of an order of minutes to an hour, while the ischemia that can also result from these tissue distortions further contributes to the tissue injury, over longer time periods, over several hours.[1-5]

Our previous research has explored the biomechanical interactions of the seated body and wheelchair cushion surface, demonstrating the importance of a cushion that is suitably adjustable to immerse and envelop the body, whether that body is healthy, or exhibits the pathophysiological changes that occur from long periods of sitting, especially post-spinal cord injury, including weight gain and loss, muscle atrophy, fat infiltration into muscles, scarring, and spasms [6-9]

In this study, our aim was to evaluate the combined risk factor of obesity and diabetes (which we are referring to here as diabesity) in patients who are chronic sitters. In bariatric patients who depend on a wheelchair for mobility, or are merely chronic sitters, sitting-acquired pressure ulcers (PUs) may become life-threatening. Increased body-weight contributes to the risk of PUs and deep tissue injuries (DTIs). This risk is further amplified when accompanied by diabetes, which causes alterations in mechanical stiffness properties of the weight-bearing tissues in the buttocks.

Methodology

We used finite element computer simulations to evaluate the biomechanical efficacy of an air-cell-based (ACB) cushion technology for individuals with these risk conditions of increased fat mass (healthy tissues) and increased fat mass combined with diabetic tissue, which pathologically alters the stiffness properties of connective tissues. Specifically, we developed 10 model variants of the seated buttocks on an ACB cushion to study the effects of fat mass and pathological tissue properties on the mechanical loads (strains and stresses) in the soft tissues of the buttocks, including muscle, fat, and skin. The distributions and localized magnitudes of these internal mechanical loads in the weight-bearing tissues were considered measures of the theoretical risk for PUs and for DTIs in particular.

Results

As fat mass increased, so did the muscle stresses and strains near the IT along with the skin stresses, in both the healthy and diabetic tissues. An interesting effect of the increase in fat mass was that the fat tissues were only mildly affected by the weight gains. The fat strain was lower in the diabetic tissue compared to healthy, but no remarkable difference was observed between healthy and diabetic fat stress.

When simulated as seated on the ACB cushion, these tissue stresses, even in the most obese simulations (“worst case patients”), were a fraction of the stresses reported in the literature for even non-obese simulated subjects (“best case patients”) seated on foam.

Discussion

Our previous work demonstrated the significant increase in internal stresses and strains that occur in obese patients when seated on stiff foam cushions.[8] In this study, we found that the ACB cushion technology damped the effects of obesity and diabetes, facilitating a minimal increase in tissues strains and stresses with the increase in fat mass, for both diabetic and non-diabetic tissue (stiffness) conditions. Our simulations therefore suggest that bariatric and bariatric/diabetic patients will benefit significantly from using an ACB cushion. The immersion and envelopment features provided by the ACB cushion drastically counteract the risk factor of the increased strains and stresses in their weight-bearing buttock tissues that result from the overweight and diabetic tissue stiffening conditions.

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3iii: Systematic Development of a Clinical Wheelchair Assessment Checklist

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Literature Review

PubMed, CINAHL, and GoogleScholar literature reviews were performed on both the development of checklists and wheelchair assessment procedures. One book systematically discussed the development of checklists and one article mentioned the effects of a checklist in a medical setting[1, 2]. One book and six articles discussed best-practices and guidelines for wheelchair assessment or wheelchair provision[3, 4, 5, 6, 7, 8, 9].

There are accepted standards for the development of checklists with many components that include "do's and dont's" for a successful checklist[1]. For example, the World Health Organization (WHO) released a checklist that was developed to reduce infections in surgical procedures and serves as evidence that they are effective[2].

Wheelchair assessment involves a variety of variables that include but are not limited to patient history, funding source, physical assessment, functional assessment, proper documentation, among others[3]. Other documents[4, 5, 6, 7, 8, 9] confirm these variables along with many others that clinicians use for wheelchair assessment.

Purpose

Clinicians perform wheelchair assessments throughout the world however, there is not a simple checklist of steps that the clinician completes in order to carry out the assessment process. Therefore the purpose of this project was to create a simple checklist of basic steps that are easy to promote organization and reduce fallibility given they have had such successes in other fields and areas of healthcare[1, 2].

Methodology

The method used in developing this checklist included three basic components; development, drafting, and validation. The process started with identification of the problem and clarification of the purpose of the checklist. Gathering information to determine what a checklist consists of as well as the underlying psychology was then discussed. Next, a review of relevant material related to wheelchair assessment was performed to identify common themes for accepted best-practice. The checklist was then produced with much consideration to the provider and consumer. The first version of the checklist underwent internal testing and modification. The checklist was then forwarded to a sample of wheelchair clinics for additional feedback and subsequent modifications.

Results
The result is a simple 10-item checklist clinicians should consider when performing wheelchair assessments. The 10 items include the following:

1. Review the reason for referral, records, demographics, and funding options

2. Perform introductions, roles, responsibilities, delivery process, time frame, and client goals/ priorities

3. Perform strength, mobility, and cognition assessments

4. Establish quantifiable means of measuring outcomes

5. Perform functional assessment (ability to perform ADL's and IADL's)

6. Assess participation

7. Review the accessibility of the natural environment

8. Perform device trials with any suitable devices

9. Re-assess client goals and priorities

10. Create a plan of action

Discussion
The Wheelchair Assessment Checklist was tested and modified to suit the needs of the clinician, the consumer, and any other member of the team included in the assessment process. Each of the 10 components of the checklist were expanded into a secondary set of instructions that further describes and explains considerations for each item. This was incorporated to aid in answering questions a user of the checklist might have.

Anecdotally, thus far, the wheelchair checklist has served well for clinicians, students, and interns new to the wheelchair service. It has also served well as a check during busy clinics when steps might be overlooked. Further scientific assessment of the checklist is needed to assess any outcome of its use.

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3iv: A Seating Advisory Team in the Netherlands

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Background

In the Netherlands, each municipality provides and pays for wheelchairs. In order to select the correct wheelchair and configuration, an advisor is consulted by the municipality. This advisor is often employed by a wheelchair supplier that the municipality has agreements with. It has been noticed that due to economic measures, less money and time is being spent on both the wheelchair selection and fitting process. These, and sometimes insufficient knowledge, are important causes for maladjustment in positioning and related seating problems (for example pressure sores, pain and instability).

In the last decade, initiatives have been taken by the Dutch SCI-units to treat seating problems in a more multidisciplinary way in the so-called Seating Advisory Teams (SAT). A small study (with a questionnaire) is done between the 7 SCI-Rehabilitation Centres in the Netherlands about their specialized seating teams. The way of working appears to be largely representative for the Dutch situation.

Clients

Most of our clients are diagnosed with SCI, MS, GB and CP. In- and outpatients can consult this independent team consisting of an OT, PT and rehabilitation technician for advice on their sitting posture. The introduction is done by the Rehabilitation Physician and, if necessary, the Wound Nurse is invited.

Goal

Main goal is to solve and/or prevent seating-related problems and to increase (perceived) seating comfort. The wheelchair assessment must result in individual solutions which enable realistic activity range for the wheelchair user. Possible goals are e.g.: optimizing posture, pressure distribution, stability, preventing or supporting scoliosis and normalizing muscle tone.

Description SAT

Before:

Clients are asked to fill in an on-line questionnaire about seating (problems) before the visit to the seating advisory team. The aim is to be better informed prior to the SAT session and to be able to work more efficiency and client-centered.

During:

The session at the SAT takes one and a half hours in total and consists of:

- an intake to identify the most important seating problems.
- an observation of the seating posture in the wheelchair and on the side of the mat
- a physical examination of the physical (in)abilities lying on the mat.

- if possible, try out- adjustments to the seating configuration (e.g. backrest) are executed with cheap materials such as pieces of foam (or folded hand towels).
- digital photos are taken from the frontal/sagittal plane of the seating position.
- optionally, pressure mapping can be executed as visual feedback for client education.

After:
The report with the results of examination, pictures, advice and agreements, is written for the client so he understands his needs regarding positioning and can explain it to others. We only provide a program of requirements, we do not mention brand or type of the equipment. In the report we

- inform and educate the client (or other relevant persons) about correct seating, instruction on cushion use etc.
- describe (effect of) changes to the seating configuration of the wheelchair.
- give advice on an appropriate alternative configuration of the wheelchair.
- give advice on training or rehabilitation treatment.

If necessary, we invite advisors or suppliers to collaborate with us in a follow-up-session. With recently implemented questionnaires (prior to and three months after the SAT) we can evaluate change in satisfaction about seating comfort (pain, fatigue, stability) on the long-term.

Strong points of the SAT:

- Independent; working primarily for the client
- The goal of the patient is our goal; optimal seating
- Multiple disciplines with different backgrounds and point of views.
- Client is actively involved in thinking and decision-making
- For inpatients we have direct contact with practitioners.
- Years of experience in rehabilitation with multiple diagnosis groups.
- If possible, adjustments are made immediately.
- Well-equipped room with several wheelchairs and cushions to try.
- If necessary we invite advisors or suppliers to collaborate with us.
- Follow-up of patients over the years

Research
From our patients admitted to the SAT it is seen that experienced problems related to seating in SCI can often be solved or seating comfort can be improved by adjusting or adapting the sitting posture (seat and/or backrest). Although it seems obvious that proper positioning is important for the quality of life, we need to keep track of the results of our interventions in a more structured way. In future, we aim to use the results of our recently implemented questionnaires for research. We can compare our results with data from the ALLRISC-study on seating in which the same questionnaires were used (presentation Linda Valent). Research in this field is important to be able to convince municipalities, health insurances companies and society of the necessity of paying more attention to proper positioning for people in a wheelchair.

3v: Clinical Utility and Therapists' Perceptions of Shared Control for Powered Mobility Assessment and Training

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Introduction

Powered wheelchairs provide opportunities for independence and increased quality of life for individuals with limited mobility.[1–4] Prior to independent use of a PWC, potential users ideally undergo skills training to ensure safety for themselves, and others in their environment.[5] However, for those who have difficulty learning the required skills, this training may be deemed unsafe as the wheelchair user poses a risk to themselves or others in their environment.[6] As a result, many of these individuals are denied the opportunity to explore powered mobility.

There are limited technologies and tools available to therapists for use in power mobility assessment and training. Therapists generally begin training in safe, simulated environments, and progress to 'real world' environments after the learner has demonstrated a degree of competence with device operation. Throughout the process, therapists rely on close physical proximity to the learner, which allows them to intervene quickly if the learner or others in their environment is at risk.[7] As a result, therapists may place themselves at increased risk, and the learner may not experience the degree of independence needed for skill development.

We have created a tele-operation (remote controlled) device, which provides the therapist with the opportunity for shared control of a powered wheelchair. While this bears similarity to attendant controlled devices currently available, it does not require the user or therapist to switch from one device to the other (seamless operation), and can be operated remotely. With this device, the therapist has the capacity to temporarily override the wheelchair user's speed and direction, as well as to perform emergency stop manoeuvres from up to 30 feet away. This device has the potential to provide increased control for the therapist, which may influence the training and assessment process by creating opportunities for techniques, which may be more suited to learners who are experiencing difficulty. This technology may also provide opportunities for data collection and display during the assessment and training process.

Objective

The objective of this study was to explore therapists' perceptions of a shared control tele-operation device, and the perceived clinical utility of shared control for assessment and training of powered wheelchair operation.

Methods

We conducted a series of semi-structured interviews with 15 occupational and physical therapists. We explored therapists' perceptions of the shared control device, including potential clinical utility.

In particular, we sought information regarding its potential for use in assessment and training of powered mobility skills. Ten participants were asked to complete follow up interviews, with the opportunity to operate a prototype shared control wheelchair to provide more targeted feedback on the potential uses of this technology. Interviews were coded by two investigators to determine themes.

Results
Our analysis identified five themes:

1. *Focus on skills, less on emotion.*

2. *Opportunities not otherwise afforded.*

3. *Backing up my assessment.*

4. *Focus on the client, not on the device.*

5. *You can't learn to play from a player piano.*

Discussion
The participants supported the concept of shared control for assessment and training. Our analysis is well aligned with a model of clinical utility for a new technology or technique which includes four factors; appropriateness, accessibility, practicability, and acceptability.[8] The themes, which emerged from our analysis, focus largely on the issues of appropriateness, practicability and acceptability. Although no specific theme speaks to issues of accessibility (resource implications, procurement), a number of participants also identified these concerns.

Conclusion
Access to shared control technology is a promising development for therapists who conduct powered mobility training for individuals with and without cognitive impairment. Participants identified the potential for positive psychological impacts on learning, practical implications on the training process, the benefit of data collection, the importance of device simplicity, and potential risks of device use. The potential of this technology must be further explored through empirical research.

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B1: Arthrogryposis - Challenges & Solutions When a Non Progressive Diagnosis Progresses

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Arthrogryposis is a neuro muscular skeletal disorder that affects various joints in the body. It is congenital and classified as “non progressive”. Mobility is limited due to the joints affected as well as muscular emaciation or weakness. Intelligence is not affected, but lack of mobility and exploration options can affect development. As the child grows and develops there are seating and positioning challenges that occur. This program will discuss the seating and positioning challenges that occur while providing case studies that show solutions. Mobility options and ideas for access for independent mobility will also be presented.

The program will review this disorder, orthopedic and therapeutic considerations, and seating and mobility challenges and solutions. There will be longitudinal case studies provided that show examples of these challenges and solutions.

- Attendee will identify two positioning challenges with someone with Arthrogryposis
- Attendee will describe the assessment/evaluation process for prescribing seating and mobility solutions for this diagnosis.
- Attendee will list two mobility options used with someone with Arthrogryposis
- Attendee will understand the challenges when surgery is not utilized with this diagnosis when considering seating options

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B2: Utilising Bio-Mechanical Principles in Conjunction with Complex Modular Seating Solutions to Continuously Support the Changing Posture and Function of a Wheelchair User

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I, Malene Ahern, have had an affiliation with an equipment, medical device or communications organization during the past two calendar years. I have worked for Seating Dynamics and Permobil as a Clinical Educator.

I, Andrew Edwards, have had an affiliation with V-Trak Ltd a medical device manufacturer, over the past 6 calendar years.

We do not believe that these affiliations produce a conflict of interest in regards to the presentation at hand. This presentation is clinical application and not product related.

Learning objectives

1. The participant will identify bio-mechanical principles that can be used to understand posture and postural dysfunction.

2. The participant will be able to list the key seating strategies to enhance client posture, function, stability and comfort.

3. The participant will evaluate three case studies where adaptive positioning has been achieved utilising modular supports.

Maintaining optimal movement during activities of daily living, occupation and leisure activities is an important clinical goal when modifying or designing a new wheelchair seating system. Comerford and Mottram (2012) state that “optimal movement ensures that functional tasks and postural control activities are able to be performed in in an efficient way and in a way that minimises and controls physiological stresses”. Thus, the ever changing postural and functional needs of a wheelchair user over a lifespan is a critical consideration for clinicians and assistive technology providers.

Understanding the nature of muscle biomechanics is useful in interpreting information gathered during a physical examination of the client. It is important to note that the length and tension properties of a muscle are closely related. These relationships adapt accordingly when a muscle habitually functions in a shortened or lengthened position. Dysfunction can “imply disturbance, impairment or abnormality which present as weakness, stiffness, wasting, sensory-motor changes or combination of impairments”. (Comerford and Mottram 2012).

Muscles can be broadly grouped as having a role of either stabilisers or mobilisers. The large mobilisers or “tonic” muscles in the body (such as rectus femoris) have a high movement/ acceleration role. In the presence of movement dysfunction they have a tendency for over activity, loss of extensibility and excessive stiffness. Conversely, muscles defined as stabilisers or “phasic” muscles have a postural holding/ anti gravity role (such as transversus abdominus or lower trapezius) and tend to become lax, weak and inhibited in the presence of pathology or pain (Janda 1983, Comerford and Mottram 2012).

The Paralysed Veterans of America Upper Limb Preservation Guidelines (2005) recommend promotion of "an appropriate seated posture and stabilisation relative to balance and stability needs" for persons using a wheelchair. This requires consideration of the client's anatomical range of movement, current seating system and wheelchair specifications.

During a seating assessment, a client may achieve better posture with the assistance of "postural support devices". The Clinical application guide to standardized wheelchair seating measures of the body and seating support surfaces defines a postural support device as "a structure, attached to the body support system or wheelchair, which has a surface intended to contact the occupant's body or extremities. Examples of postural support devices are the back support, seat cushion, or lateral trunk support" (Waugh and Crane 2013). These may also include anterior pelvic supports and trunk supports.

Optimal posture ensures minimising prolonged static loading of global mobiliser muscles and maximising function of local stabiliser muscles. A stable trunk and pelvis is essential for optimal upper limb functional tasks such as reaching and wheelchair propulsion. Thus, it is essential to evaluate the client's ability to maintain optimal posture and provide extra support for example, to stabilise the pelvis using anterior pelvic supports. Another example, the trunk can be stabilised with the use of a modular backrest which provides adequate lumbar support and encourages neutral lordosis. Furthermore, when determining suitable seating solutions for our clients it is imperative to review ISO standard tests for postural support devices which tell you whether or not a product meets defined performance criteria when subjected to loads during intended use.

In conclusion, faulty movement patterns and habitual postures are linked to pathology, pain or lack of postural control. It is essential to understand how commonly occurring asymmetries of the spine impact on the development of postural deformities and implement preventative measures to encourage dynamic seating and optimal movement. In our practice, we have found that an adaptive modular seating system using postural support devices can be used effectively to both correct and accommodate posture over time for a wheelchair user.

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B3: Standing Up to Complications of Spinal Cord Injury/Disease

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Disclosure: Ginger Walls, PT, MS, NCS, ATP/SMS is employed full time as a Regional Clinical Education Manager with Permobil.

Learning Objectives

1. Participants will be able to identify 3 common secondary health conditions associated with SCI/D.

2. Participants will be able to identify 3 benefits of standing for persons with SCI/D as evidenced by the research.

3. Utilizing the ICF Model, participants will be able to discuss and apply 3 evidence-based benefits for functional activities, participation, and body structure/function offered by a wheelchair-based standing device.

Discussion

Imagine the possibilities if every person with a Spinal Cord Injury/Disorder (SCI/D) had his/her needs compensated as far as possible by aides with the same technical standard as those we all use in our everyday lives.

The secondary health conditions and causes of mortality for persons with SCI/D are well-documented (Groah 2012). These include complications in the areas of skin breakdown, bowel and bladder, bone density, obesity, respiratory impairments, upper extremity repetitive stress injuries, lower extremity contractures and spasticity, pain, and depression. Decreased participation and loss of independence with function are also related risks.

The benefits of standing for persons with SCI/D and other neurologic disorders are also well-documented (Dicianno, et al 2013), including positively impacting these secondary health conditions, as well as the limitations on function, independence and participation listed above. Considering the literature, it is evident that many of the complications of SCI/D could also be considered complications of long-term sitting.

Physical and occupational therapists utilize various pieces of equipment during skilled therapy to facilitate standing for those clients who are unable to stand independently. A client's access to the recommended standing device at home allows them to achieve optimal long term self-dosage of standing and also helps them avoid the documented complications of long-term sitting. In the ICF Model "External Characteristics" are those aspects of the client's environment, including access to health care services and complex rehab technology needed, which influence their health and functional outcomes. Utilizing the International Classification of Functioning, Disability and Health (ICF) model (Andriaasen, et al 2013), and applying what we know about how wheelchair seating systems are used in everyday life (Walter, et al 1999; Sonenblum, 2011), the application of wheelchair based standing devices can be considered a best practice tool for improving participation, functional independence, and body structure/function issues for many persons with SCI/D.

This presentation will also utilize case studies to illustrate the application of wheelchair based standing devices as, not only an evidence based, but also a value-based, or most cost-effective, means of minimizing risks for complications while maximizing function. Finally, this presentation will discuss clinical rationale, justification and documentation tools to support for wheelchair based standing functions.

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B4: Conquering the Complexity of Writing a Letter of Medical Necessity

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I, Erin Baker, do not have an affiliation (financial or otherwise) with an equipment, medical device, or communications organization.

Mobility evaluations for complex rehab are challenging, but beyond the evaluation the thought of completing the required paperwork to gain funding for this equipment is overwhelming. Writing a quality letter of medical necessity is an important component to acquiring funding and ultimately to providing appropriate and necessary seating and mobility products to clients. Thankfully, composing a LMN does not have to be as time consuming and daunting as one may think. This instructional course is designed to address the common concerns and fears about writing a LMN, provide education regarding the components that should be included in a LMN, and discuss how to make the writing process efficient and effective.

A high quality LMN is imperative for multiple reasons and is directly related to being able to provide necessary equipment to an individual who requires seating and mobility equipment. In a LMN it is necessary to be able to clearly and concisely express to someone who may have no background in durable medical equipment the needs of an individual the reviewer knows nothing about.

Concerns regarding style and content of a LMN are common and have led to use of premade forms and LMN generators. While these resources are helpful, they often provide only the information needed to complete justification of the equipment and its components but do little to aid in describing the individual and their needs. In order to explain why a piece of seating or mobility equipment is medically necessary the reviewer needs to understand who the individual is as a person, what their medical condition is, how this condition affects them physically, as well as how it affects their ability to participate in their world day to day. In this course we will discuss the essential components of a top notch LMN as well as how to organize it in a clear and succinct manner.

In an environment where funding is decreasing and the paperwork necessary to try and get what little funding is available, time has become a fleeting commodity. LMN's are required paperwork for most payer sources, but most do not have the available time needed to create these documents. Fortunately with time and practice, as well as some help from ever evolving technology, I have found several ways to decrease the time needed to generate a LMN without compromising quality. These methods have significantly cut down on time spent sitting behind a computer, which in turn increases the speed with which the process of acquiring seating and mobility equipment begins and deceases the time an individual in need must wait for their equipment.

While seating and mobility equipment can be very complicated, the process of getting it does not have to be. With methods and tips from a full-time seating and mobility therapist you too can create a comprehensive LMN which will reduce the chance of denial and decrease wait time for the individual in need. Not only will you be able to generate a high quality LMN, but also complete it in a reasonable time frame which will decrease stress and frustration with the seating and mobility equipment acquisitions process.

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B5: The CanWheel Power Wheelchair Outcomes Toolkit: Overview and Application

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Introduction

Mobility disability is prevalent among older adults[1]. Provision of a power wheelchair (PWC) is a common rehabilitation intervention intended to mitigate associated limitations, such as reduced participation in life activities. Although PWCs can improve function and overall quality of life[2-4], use of these devices in later life can also involve challenges for older adults[5,6]. To date, limited empirical evidence exists to help us understand how older adults adapt to their wheelchairs once the devices have been prescribed, in part, due to the lack of validated PWC-specific outcome measures. One component of the CanWheel Research Team's mandate is to study the psychometric properties of a toolkit of outcome measures that will advance our knowledge and understanding in this area.

The CanWheel Power Mobility Outcomes Toolkit includes four measures[7]. These measures were selected based on the Consortium for Assistive Technology Outcomes research taxonomy[8] in order to capture critical information about *effectiveness* (objectively examines the impact of the PWC at the individual wheelchair user's level with a focus on functioning in activities and participation), *social significance* (examines the impact of the PWC on society, from the caregiver perspective) and *subjective wellbeing* (examines the impact of the PWC on psychological functioning [e.g. confidence] and quality of life [e.g., perceived participation]).

Focus/Approach

In this instructional session, investigators from the CanWheel team will introduce four of outcome measures, including the Wheelchair Skills Test for Powered Wheelchair Users (WST)[9,10], the Wheelchair Use Confidence Scale for Power Wheelchair Users (WheelCon)[11], the Assistive Technology Outcome Profile for Mobility (ATOP)[12], and the Caregiver Assistive Technology Outcomes Measure (CATOM) – Power Version[13,14]. In addition, the session will provide an overview of the administration, scoring and interpretation of scoring of these measures. Interactive discussions regarding their clinical relevance will be facilitated. Using a case-based approach, we will show how the outcome measure scores can be combined to provide a comprehensive profile of the power wheelchair user and its importance in the development of a targeted intervention.

Take-home message

The Power Wheelchair Outcomes ToolKit includes outcome measures designed to capture information about wheelchair skills, effectiveness, social significance, and subjective wellbeing of individuals who use PWCs. On completion of the workshop, participants will be able to integrate these measures into research or clinical practice. Specifically, participants will be able to:

1. Describe, administer, score, and interpret the scores of the WST, WheelCon, ATOP, and CATOM.

2. Identify how scores from the WST, WheelCon, ATOP, and CATOM can be used in combination to optimize their applicability and utility in development of targeted interventions for power wheelchair users.

3. Describe how use of the Power Wheelchair Outcomes Tool Kit enables the development of a more targeted, comprehensive intervention plan in comparison to an intervention developed on the basis of only 1-2 outcome measures.

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B6: Transit Standards for Seating, Wheelchairs, and Wheelchair Tiedowns

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Individuals who remain seated in wheelchairs while travelling in vehicles are “45 times more likely to be injured in a crash than the typical passenger”[1] (p. 2). The “typical” passenger in a vehicle transfers into the vehicle manufacturer’s seat, which is secured to the vehicle, and uses the occupant restraint system; that is, the seat belt system that also is secured to the vehicle. Individuals who must remain seated in wheelchairs while travelling in vehicles also are at risk of injury in “non-collision events”, such as sudden braking or sharp turning, resulting in the wheelchair tipping, securement failure, or the occupant falling out of the wheelchair[1] (p. 4). Many individuals who must remain seated in the wheelchair during transit do not have postural control or the ability to stabilize themselves or their wheelchairs during these non-collision events, which can result in serious injuries.

The position paper on Wheelchairs Used as Seats in Motor Vehicles by the Rehabilitation Engineering & Assistive Technology Society of North America (RESNA) states that the “ideal” safety practice is for individuals who use wheelchairs to “transfer into a manufacturer-installed vehicle seat and use the vehicle’s crash-tested occupant restraint system”[1] (p.5). This is not always possible; for example, if a person is unable to safely transfer into a vehicle seat or requires the postural support provided by the wheelchair seating system.

Wheelchairs Used as Seats in Motor Vehicles (WC19)

If a person must remain seated in a wheelchair while travelling in a vehicle, it is important that the wheelchair meets certain standards. *“WC19 is a voluntary industry standard for designing, testing and labeling a wheelchair that is ready to be used as a seat in a motor vehicle. A WC19 wheelchair has:*

- *Four permanently attached and labeled securement points that can withstand the forces of a 30 mph, 20 g impact.*
- *Specific securement point geometry that will accept a securement strap end fitting hook.*
- *A clear path of travel that allows proper placement of vehicle mounted occupant safety belts next to the skeletal parts of the body,*
- *Anchor points for an optional wheelchair anchored pelvic safety belt, that is designed to withstand a 30 mph, 20 g impact, that has a standard interface on it that allows it to connect to a vehicle-anchored shoulder belt.”* [2]

Each bullet point is explained in more detail below.

Permanently Attached Securement Points
The four securement points on a wheelchair are the brackets installed on the wheelchair – two at the front of the wheelchair and two at the rear of the wheelchair – to which securement straps can be attached. The required label that indicates that the wheelchair securement points conform to the WC19 standards is a hook symbol. If the metal rings do not have the hook logo, it means that the wheelchair has not been crash tested successfully for occupant safety.[3]

The forces that the securements points must withstand – 30 miles per hour (or 48 kilometres per hour), 20 g impact – refer to the testing standards. Thirty miles per hour is the same standard that is used for testing passenger vehicles and child safety seats.4 When testing wheelchairs for WC19 compliance, the wheelchair is secured to a sled on a test track and an appropriately-sized crash test dummy is secured to the wheelchair. A frontal impact sled test is used in which there is a 30 mile per hour change in speed, simulating a frontal crash. A sudden change of speed of 30 miles per hour represents the 95th percentile of crash severity of frontal crashes of cars, minivans and SUVs.[4] Therefore, most crashes in the "real world" will be less severe than the testing conditions.

Securement Point Geometry
The geometry of the securement point must allow for one-handed attachment of the hook of a tiedown strap when a driver or caregiver reaches for the securement points from one side of the wheelchair.[1] This means that the securement brackets are easily identifiable and easily accessible. In addition, when tiedown straps are applied to the securement points on the wheelchair and to the typical anchor points on the floor of the vehicle, the position of the straps should not be close to any sharp edges that could damage the strap material in the event of a crash.

Clear Path for Placement of Vehicle Mounted Occupant Safety Belts
A WC19 compliant wheelchair may be used with a wheelchair tiedown and occupant-restraint system (WTORS) in a vehicle. A WC19 compliant wheelchair allows for the easy passage of the shoulder belt, from the mounting in the vehicle and connecting to the pelvic belt near the hip of the wheelchair seated individual, without getting in the way. "The shoulder belt needs to be snug and positioned over the middle of the clavicle and across the sternum, and then connect to the pelvic belt near the hip"[5] (p. 11). Wheelchair manufacturers are required to disclose the rating that each wheelchair model is assigned after undergoing independent testing with respect to accommodating the proper use and positioning of a vehicle anchored belt-restraint. The ratings are poor, acceptable, good or excellent.[1]

Anchor Points for a Pelvic Safety Belt
A pelvic safety belt is different than a positioning belt that is used for postural support in seating. Unless they have been labeled as having been crash tested, postural supports, such as positioning belts and chest harnesses, do not provide for restraint for an occupant seated in a wheelchair in a vehicle. In contrast, a safety belt is "a length of energy-absorbing webbing material used in occupant restraint systems."[6] That is, a pelvic safety belt is specifically designed, tested, and labelled for crashworthiness. A WC19 compliant wheelchair has anchor points that allow for the installation of a pelvic safety belt that meets the testing standards.

It should be noted that WC19 is a voluntary standard, which means that it has not been mandated by federal or provincial legislation. Many wheelchair manufacturers have their products tested in order to be WC19 compliant, however, not all wheelchairs have been tested or meet these standards. If a person will be using a wheelchair as a seat in a motor vehicle, or may in the future need to remain seated in a wheelchair during transit, it is important to consider the safety of the wheelchair at the time of prescription. If a product is prescribed that is not crashworthy, the rationale for its prescription "should be clearly documented to avoid possible confusion for parents and transporters over who made the final decision and why, if the lack of transit technology should result in injury"[5] (p. 9).

Wheelchair Tiedowns and Occupant Restraint Systems (WTORS)
The wheelchair tiedown part of WTORS refers to securing the wheelchair to the floor of the motor vehicle, while the occupant restraint system refers to providing restraint to the person in the wheelchair. Both are required to enhance safety when seated in a wheelchair while travelling in a motor vehicle.

Wheelchair tie-downs typically refer to a four-point strap tiedown system. A **four-point strap tiedown system** is *"a method for securing a wheelchair where four straps are attached to the wheelchair at four separate securement points and attached to the vehicle at four separate anchor points."*6 A four-point strap tiedown system is most commonly used on public transit, paratransit and school buses as it can adapt to a range of wheelchair sizes and models.[1]

When attaching the tiedown straps to the securement points on the front of the wheelchair, the straps should be angled slightly outward, such that the attachment points on the floor are wider than the width of the wheelchair to add lateral stability.[3,5] The position of the front tiedowns is important to enhance lateral stability to minimize the risk of tipping during a sudden driving maneuver. The front tiedowns should attach to the floor at an angle between 40 and 60 degrees (relative to horizontal).[5,7]

The tiedowns that attach to the securement points on the rear of the wheelchair should be attached "straight back to the floor."[5] (p. 10). These tiedowns should attach to the floor at an angle of 30 to 45 degrees (relative to horizontal). [5,7] It is noteworthy that the rear tiedowns usually take twice the amount of force compared to the front tiedowns and therefore their correct placement is important.[5]

Wheelchair tiedowns also may refer to docking systems, which are commercially available mechanical systems that secure particular wheelchairs to particular vehicles. A **docking tiedown**, therefore, is "a method for securing wheelchairs where portions of the wheelchair frame, or add-on components fastened to the wheelchair frame, engage with a securement device anchored to the vehicle."[6] This would be most commonly used in a privately-owned vehicle for a specific wheelchair. This replaces the need for using a four strap tiedown system and can promote independence with securing one's wheelchair to one's vehicle.

Whether a strap tiedown system or a docking system is used, an occupant restraint system is necessary in either case. An **occupant restraint** is "a system or device designed to restrain a motor vehicle occupant in a crash by keeping the occupant in the vehicle seat and minimizing contact with the vehicle interior, other occupants, or objects outside the vehicle."[6] An occupant restraint system is a three-point lap and shoulder belt system that has been crash-tested. A pelvic safety belt has been specifically designed and tested for crash-worthiness and is used in conjunction with a shoulder belt anchored to the vehicle to provide restraint to the hips and torso in the event of a crash. "The shoulder belt needs to be snug and positioned over the middle of the clavicle and across the sternum, and then connect to the pelvic belt near the hip"[5] (p. 11). The pelvic belt must fit low on the hips to minimize risk of injury in the event of a crash.[8]

Just as a wheelchair must meet certain standards to be deemed WC19 compliant, so too must tiedown and occupant restraint products. The **standards** for tiedown and occupant restraint products require that:

- *"pelvic and shoulder restraints be used in the tests and recommend use of both belts during transport, especially in vehicles that have occupant restraint belts normally installed,*
- *a dynamic 30 mph (48kph) frontal-impact test be used to confirm the performance of the WTORS,*
- *the end fittings on tiedown straps meet a specific design so that the end fitting will readily latch to the mating receptacle on the transport-compliant wheelchair,*
- *the product be permanently labeled as to the test passed,*
- *instruction and warnings be provided for both installers and users."* [4]

In addition, an effective WTORS *"must provide for the release of the wheelchair and occupant in under 60 seconds by a single attendant."* [7]

Wheelchair Seating Systems for Use in Motor Vehicles (WC20)

WC19 is the voluntary standard related to wheelchairs used as seats in motor vehicles. It is recognized that one manufacturer's seating system, however, may be affixed to another manufacturer's mobility base. Thus, when looking at safety for individuals who must remain seated in their wheelchairs, it became apparent that there should be separate testing to evaluate the design and performance of wheelchair seating systems separate from specific wheelchair frames. WC20 is the voluntary standard for wheelchair seating systems used in motor vehicles. Wheelchair seating includes seats and back support with attachment hardware.[1]

In order to test the crashworthiness of seating and attachment hardware, a surrogate wheelchair base is used. The surrogate wheelchair base, which can withstand repeated 48 kph/20 g crash tests, is able to accommodate various sizes and types of commercial seating.[9] In order to test the seating, the seating is attached to the surrogate wheelchair base with its attachment hardware and the wheelchair base is secured to a frontal impact sled with 4-point tiedowns. An anthropomorphic test device, or "crash test dummy", is secured with a 3-point occupant restraint system. The testing is completed to ensure that the crash test dummy remains in a seated posture at the completion of the test and does not "submarine" under the pelvic safety belt. In addition, the attachment hardware must remain attached to the seating system and to the wheelchair[9] and no part of the seating system weighing greater than 100 g should break loose[10]. If a piece broke loose while in a collision, it could become a projectile and injure others in the vehicle.

It is intended that WC20-compliant seating is installed on a WC19-compliant wheelchair base. The base must then be secured to a vehicle with an approved Wheelchair Tiedown and Occupant Restraint System (WTORS). "The combination of these devices is indicated to obtain the best possible performance when in a transit condition."[11] (p. 4).

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What Matters Most - Hosting a Difficult Conversation

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Welcome to the treacherous subject of mortality.

It is a subject that evokes a lot of emotion and challenges our own thoughts and actions.

Those of us involved in Assistive Technology have developed an expertise about options we can offer people to improve their functional abilities. Many of us are very comfortable with the notion that we are not offering any “cures”; we are offering care to persons who are living with a long-term functional impairment. We have worked hard to become “experts” in our field. We KNOW a lot about the available technologies we can recommend and provide to people; especially when we have to establish the “medical necessity of an item”; in order to get the items funded.

When do we face situations that we can’t solve the problem? Have you tried to “correct” the curved spine of a young man with Muscular Dystrophy, only to find the mold was ripped out of the chair the week after delivery? Have you prescribed and delivered the head array power chair with the vent rack, for a gentleman with ALS to find out the chair is in the garage the man sits in the recliner chair next to the bed? I have experienced both of these situations and my initial thought is “what’s wrong with these people? Do they know how hard I worked to get them this “solution”?

Here is a view from the client’s perspective; which caused me to pause and think about my “expert” care. This is an excerpt from a New Time Magazine article written by Harriet Mc Bride Johnson in 2003.

> It’s not that I’m ugly. It’s more that most people don’t know how to look at me. The sight of me is routinely discombobulating. The power wheelchair is enough to inspire gawking, but that’s the least of it. Much more impressive is the impact on my body of more than four decades of a muscle-wasting disease. At this stage of my life, I’m Karen Carpenter thin, flesh mostly vanished, a jumble of bones in a floppy bag of skin. When, in childhood, my muscles got too weak to hold up my spine, I tried a brace for a while, but fortunately a skittish anesthesiologist said no to fusion, plates and pins -- all the apparatus that might have kept me straight. At 15, I threw away the back brace and let my spine reshape itself into a deep twisty S-curve. Now my right side is two deep canyons. To keep myself upright, I lean forward, rest my rib cage on my lap, plant my elbows beside my knees. Since my backbone found its own natural shape, I’ve been entirely comfortable in my skin.
>
> I am in the first generation to survive to such decrepitude. Because antibiotics were available, we didn’t die from the childhood pneumonias that often come with weakened respiratory systems. I guess it is natural enough that most people don’t know what to make of us.

I first read this article in 2003 and it has stuck with me. I remember asking myself, “do I “allow” my clients to a jumble of bones in a floppy bag of skin? Am I comfortable to listen to someone who says, “since my backbone found its own nature shape, I am entirely comfortable in my own skin.”? Initially my professional response was, “this not a therapeutically appropriate” sitting position”. I struggled with the tension of providing consumer-centered care and providing “expert” interventions. I am glad to report, however, I have evolved enough to recognize that for many clients with progressive neurological diseases, the not so “therapeutically appropriate position” in many cases is actually FUNCTIONAL for the person, and this is a “SOLUTION” for that person!

More recently I read “Being Mortal” by Atul Gwande; a neurosurgeon from Boston who has written extensively about all kinds of topics in healthcare. This book is about his own journey in learning about “difficult conversations”, especially in an acute care teaching hospital environment and his own family’s struggles when his father was diagnosed with cancer. Gwande points out over and over again, the discomfort we, as health care providers, feel when we cannot “cure” a disease or when our technology or medical interventions cannot “solve” the problem. I particularly like his exploration of autonomy. He writes. “ – you may not control life’s circumstances, but getting to be the author of your life meaning getting to control what you do with them.” Gwande’s writings remind me of the importance of being mindful of my role in letting a client be the author of his/her life. I have learned to resist being the “expert”, and have had to learn to actively listening to the client. Practicing “active listening” is much harder than is sounds, but it an essential skill for hosting difficult conversations. Allowing a person to “be the author of his/her life” reminds me to be strive to be *partner* in an “Interactive Model of Care” and not be a practionner of the “Expert Model of Care”.

In his blog, “Dis Ease Diaries”, Bruce Kramer describes his experience of living with ALS. He notes when we cannot cure a disease, there is a pervasive “DIS EASE” in communication about the current situation and any discussion about “the future”. He describes the hierarchy of brain function and how we react to information about terminal illness and mortality. He points the language we often use; including phrases like, “we are going to “fight” this thing” or “we are going to overcome” or “we going to beat it”. Kramer points out, each of these are the expressions of our “fight to flight” reaction, a lower brain reaction; a part of the brain that is critical for survival. However, Kramer further points out; we, as humans, have a neocortex which allow us a higher level of thinking. He shares his experience of tapping his own neocortex, recognizing and acknowledging his anger at the diagnosis, his fear of dying and the process by which is allowed himself to let his neocortex to “be heard”. In listening to his neocortex, he opened himself to the gift of presence. Open to what life offered, right now, knowing life will be short. He found ALS became “A Loving Syndrome” – a reason to be open *with* and *to* others. He notes he would not wish the diagnosis on anyone, but recognizes the gift he has been provided; as a result of needing to face his own mortality.

This talk is about checking in on our own Dis-EASE with loss of function and mortality, especially when working with persons with a progressive disability or a terminal disease. I named this talk “Hosting a conversation”; because hosting infers a welcoming of others. In order to welcome others into a difficult conversation, especially around the treacherous conversation of morality, I want to invite you to explore your own level of Dis-ease with the topic.

To host a conversation, we must be willing to engage in “appreciative inquiry”. Have a true curiosity and openness about what the other person knows about, is thinking about, and wants to talk about regarding his/her decline and morality.

To host a difficult conversation one must be open to develop the *will*, the *skill* and the *ability* to engage in such a conversation.

To have the WILL, involves an exploration of :

- Self- Awareness – What is your comfort level about the topics of aging, loss of the function, decline, death and dying?
- Self-Management – Do these subjects evoke emotions that result in avoidance of the subjects or difficulty controlling your own emotions?

The emotions that come up for each of us are *real* and are not to be denied. The important step in preparing for the difficult conversation is to take time to prepare. To recognize your own emotional triggers and look for ways to put *your own* emotions “to the side” to focus on the other person, to whom you are offering an invitation into this conversation. There may be times when you can not put your own emotions “to the side” and that is OK. It is important to recognize those times and ask others to for assistance and support, to allow others to host the conversation.

To have the SKILL, we need to be engage in and consistently try to practice Active Listening – which is a very challenging skill. Active listen includes the intent to give your full attention to other person. Be ready to ask open ended questions and to be open to hearing and seeking to understand the responses. Questions that include:

- What do you know about your condition?
- How to feel about your situation?
- What is working for you, now?
- What does a good day look like for you?
- What matters most to you?

The ABILITY to host the difficult conversation, involves your willingness to be comfortable in asking these questions with a genuine intent to hear and understand the other person’s response. Genuine intent also includes being open to any response the person may give, and to see that response as a reflection of where that person is, and be willing to meet the person at that place.

In 1999, it was *my* mother who had been diagnosed and was undergoing treatment for cancer. At that time, I gave my open ended question to enter into this most difficult conversation with my father, a tremendous amount of thought. Finally, I was able to ask my Dad, a deeply religious man, “Dad, what are we praying for?” *My* intent was to hear what tests results we were looking for, what were the prognostic indicators that Mom would be cured, what were the doctors telling them?

My Dad’s response, “I say a prayer every night for a full life and a quick reward”. This was not the answer I was expecting or actually looking for. I wanted to data, facts, lab results; but he gave me an answer, which proved to be very valuable to me. Less than a month later, following a negative reaction to a chemotherapy, my mother opted to stop treatment; she had had a full life, even through 15 months of chemo and radiation treatment. Within a week of her decision, she died at home, with her family together, quickly earning the reward my father had prayer for; and the reward

I knew she had earned during her very full life.

I am encouraging each of you to explore to your own level of Dis-ease with aging, progressive illness, death and dying. There are gifts to be received in being open to hearing what matters most to others and be *that* provider, who helps the person be the author of his/her own life and be able to experience lots of “good days”.

Later in the conference we will have a chance to hear from members of the Vancouver community about their lives, as persons living with a progressive disability and to hear what matters most to these folks. I look forward to your joining me in this exploration of a most challenging subject.

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Wheelchair Skills Assessment and Training – What in the World is Going On!?

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Learning Objectives
Participants will be able to:

1. Describe the World Health Organization (WHO) Guidelines on the Provision of Wheelchairs in Less-Resourced Settings.

2. Access the WHO Guidelines and related materials from the WHO website.

3. Describe the role of wheelchair skills assessment and training to the global wheelchair service delivery process.

Overview of Instructional Session
This session will provide an overview of the developments in global wheelchair service delivery since the release of the paradigm-changing World Health Organization (WHO) Guidelines on the Provision of Wheelchairs in Less-Resourced Settings, will show the relevance of the low-tech and high-impact Wheelchair Skills Program (WSP) to these developments and will suggest directions for the future.

Background
In 2008, the WHO released its Guidelines on the Provision of Wheelchairs in Less-Resourced Settings[1]. Training packages[2-4] have subsequently been released to assist practitioners in meeting these Guidelines. A number of organizations, universities and agencies are now involved in the implementation of these training packages and certification of providers. A new organization, the International Society of Wheelchair Professionals (ISWP)[5], was formed in 2015 to help lead and coordinate these efforts.

The WHO Guidelines include an 8-step process for wheelchair service delivery. Two of these steps – assessment and training – are relevant to the WSP[6] that includes assessment and training protocols (the Wheelchair Skills Test and Wheelchair Skills Training Program)[7].

Take-home message
The gold standard of practice in 2016 for wheelchair professionals includes the following principles:

1. Wheelchairs should be provided using the 8-step process of the WHO.

2. All people who use wheelchairs and their caregivers should have their wheelchair skills assessed.

3. Wheelchair skills training should be provided, if appropriate.

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WHO Wheelchair Service Training Package for Managers and Stakeholders. http://www.who.int/phi/implementation/assistive_technology/wheelchair_train-pack_managers/en/.

International Society of Wheelchair Professionals. http://www.wheelchairnet.org/.

Wheelchair Skills Program Manual. http://www.wheelchairskillsprogram.ca/eng/manual.php.

Dynamic link (automatically updated) of PubMed and grey-literature citations regarding the Wheelchair Skills Test and Wheelchair Skills Training Program
http://www.wheelchairskillsprogram.ca/eng/publications.php.

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1i: A New Trial of All Rental Wheel Chairs and Walking Aid Devices in Kaihukuki (subacute) Rehabilitation Hospital

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Introduction

In our country wheel chair and walking aid devices have been underestimated as medical rehabilitation devices. We tried and have continued that those devices should be employed suitably, comfortably fitted for the patients with multiple, various diseases and conditions during rehabilitation process toward to return to their own home[1]. So we applied all rental using system and tried to ensure the effect from the patients and professionals satisfaction and ecological and managial point of view.

Method and Objects

Our hospital has 168 subacute beds and 57 chronic beds except severe disabled children. Total1135 patients every year were treated. Our new trial of All rental wheel chairs and walking aid devices is designed with the rental company cooperation which has worked mainly in public care insurance.

All devices are delivered within three days when the patients are admitted to the hospital with precise maintenance and sanitation. The evaluation of satisfaction was done by QUEST version 2 (translated in Japanese in 2008)[2].

Results

1.At the beginning of this system, we compared with the rental devices(n=28) and the original order made devices(n=22) from Sept 1until Nov 30, 2010. There were no significantly difference among the scores of the total satisfaction, satisfaction with devices and the service.[2] The scores of the satisfaction in each item were highly superior to the scores of Japan Techno-aid Center Report 20103).[3] Since Dec.1 2010 we have started this system and follow up study. The staffs and the patients have the positive effect in dealing with various kinds of the devices from the beginning of rehabilitation process along more suitable and comfortable situation. The ecological view is to reuse those devices cheaper and safer. And also we can save the space for a wide device warehouse.[4] Only demerit is that we can not get official supports from medical insurance. The cost of these rental sytem needs one dollar a day per a person.

Discussion

In Japan wheel chairs and walking aid devices should be estimated only as the hospital equipment not as superior devices along rehabilitation process and giving the mobility and stability for the patients with a disability. In the changing process of rehabilitation we need multiple types and sizes for various diseases and conditions of the patients. We can not make temporal efforts for this kind of problem. We do not adapt the patients to the devices. In medical insurance Prosthesis and orthosis are given to an ordinary position but wheel chairs and walking devices are not. So our trial of all rental devices would be proposed to better devices for the patients at the rehabilitation process cheaper and safer as early as possible. From the ecological point of view we reuse the origins and save the space. But through five years experiences we have to promote the quality of fitting skill.

Conclusion

QUEST is a very useful evaluation for the satisfaction with assistive Technology. The comparison between rental devices and original those devices showed almost equal and no inferiority of satisfaction.

During five years experiences, we feel to continue the quality of fitting skill

We would like to support the seamless using the wheel chairs and walking aid devices from the hospital to the community especially for the persons with severe disability.

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1ii: Test Retest Reliability and Discriminatory Validity of the Wheelchair Components Questionnaire for Condition

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Durability, while only one aspect of a wheelchair's utility, is important because wheelchair breakdown results in the disruption of a wheelchair user's life and may cause clinical complications and injury[1,2].

The condition of a wheelchair after a known period of use reflects the durability, ease of repair and the effectiveness of a maintenance protocol[3]. Advocacy groups, medical funders and insurance agencies have attempted to track failure through repair records. Although the methods of recording component failure may vary widely, researchers have attempted to use these records to compare the durability of different types of wheelchairs[4].

It may be difficult to discern problems with durability, maintenance and repair if data is buried in a broad wheelchair evaluation, and most available tools for wheelchair evaluation include a wide variety of factors that impact wheelchair usability[1,5].

We have developed a preliminary version of a questionnaire focused on eliciting feedback on the condition of wheelchairs which have been in use for a period of time. The Wheelchair Components Questionnaire for Condition (WCQc) was designed to be completed in less than 20 minutes and provide quantitative data suitable for analysis using parametric statistical methods, as well as explanatory qualitative comments for each component[3,6,7].

The goal of this study was to confirm test- retest reliability with intra-class correlation (ICC) scores above 0.80, and to confirm discriminatory validity with ANOVA scores indicating significant differences ($P<0.05$) between wheelchair components and between wheelchair types.

The WCQc consists of a total of 17 questions in two domains regarding the condition of key wheelchair components. Each question utilizes a visual analogue scale with anchors and includes an opportunity for a qualitative explanatory comment. Letters akin to school grades were used to anchor the visual analogue scale. This was intended as a generally understood calibration to improve inter-rater reliability and enables intuitive understanding of results. The first domain, which is intended for use as a stand-alone questionnaire, includes those components found in virtually every wheelchair and also includes a question asking for an overall rating. The second domain, not intended for use as a standalone questionnaire, includes parts which may not be present on all wheelchairs.

Data collection for this study was completed during the 31st Annual International Seating Symposium. Used wheelchairs were obtained from the pool of used wheelchairs donated through a regional office of a large international charity. Two manual wheelchairs, a TiLite TRA and a pediatric Quickie HP, which were worn but still functional and which would have most of the components listed in the WCQc were employed. Conference organizers enabled the research team to set up a small area for data collection in the exhibit. Undergraduate research students walked through the exhibit hall interacting with conference attendees and invited clinicians and technicians with more than two years of wheelchair experience to participate in the study. Participants used the WCQc to evaluate one or the other of the study chairs and then returned at least one day later to evaluate the same wheelchair a second time.

Study protocol was approved by the LeTourneau University Institutional Review Board. The need for a consent form was waived because names and demographic information other than years of wheelchair experience were not collected; each was simply given an identifying number.

Statistical Analysis: Data was tested for normality with the D'Agostino-Pearson test. Inter-Class Correlation (ICC) was calculated for Domain 1 and for the entire questionnaire using the mean scores for each participant. Analysis of variance was completed to look for significant differences between the two study wheelchairs and between the questions (components) included in the WCQc.

Thirty five participants completed the study (20M, 15F) with an average of 15.9 (SD 10.4) years of experience with wheelchairs. Test re-test intra-class Correlation Coefficient for the domain 1 of the WCQc was 0.91 with a confidence interval of 0.82 – 0.95. ICC for the entire questionnaire including domains one and two was 0.93 with a confidence interval of 0.87-0.97.

Two way ANOVA for the wheelchair and components factors indicated that the two wheelchairs were rated significantly differently ($P<0.001$ $f(1,35)=23.41$) and the components were also rated significantly differently ($P<0.001$ $f(15,35)=5.81$). Tukey comparison of means for the interaction factor indicated which components were rated highly or poorly for each wheelchair. Comments accompanying each question provided qualitative data for the reasons behind the ratings.

Neither wheelchair had a tray, so the question regarding the tray is not included in this analysis. The TriLite wheelchair did not have a headrest or armrests, and the Quickie chair did not have an abductor block, so the analysis of results for those questions have somewhat reduced statistical power.

In addition to the discriminatory power resulting from questions producing data suitable for ANOVA analysis, the single focus of the WCQc is also likely to further enhance discriminatory validity. For example, in a multifocal questionnaire, a wheelchair component might be rated by clinicians as providing adequate mobility, and having good adjustability but poor durability. If all of these aspects are included in one score, useful information may be obscured. In a similar way, if multiple components are lumped together, discriminatory ability may be lost.

The WCQc was developed and has been primarily used in low resource settings. Most of the participants in this study primarily work in North American settings. Further reliability validation with clinicians who primarily practice in low resource settings is planned.

Results support our hypothesis that domain one of the WCQc and the entire WCQc shows test-retest reliability and discriminatory validity confirming the WCQc as a reliable and valid tool for the assessment of wheelchair maintenance condition.

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1iii: Manual Wheelchair Data Logging: Outcomes, Challenges and Barriers

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Introduction

Wheelchairs are frequently prescribed in the world of rehabilitation to facilitate independent mobility and promote social participation of individuals with mobility limitations. Manual and powered wheelchairs are used by more than 220,000 Canadians[1] and nearly 3.3 million Americans[2]. In order to understand the use and impact of wheelchairs, it is important to document the mobility characteristics of wheelchair users in the community and to obtain an accurate account of their activity levels. In recent years, studies have increasingly employed data logger technologies to objectively document driving and physiological characteristics of manual wheelchair users. However, the technologies used offer marked differences in characteristics, including measured outcomes, ease of use and level of burden, among other variables. This disparity in the literature may be confusing to clinicians and researchers alike. Thus, in order to obtain an overview of what has been done until now to quantify and objectively assess manual wheelchair use, we undertook a scoping review of the scientific and gray literature. This review aimed to identify and describe the range of data loggers and the underlying technology features used to measure manual wheelchair use and activity, as well as physiological characteristics of wheelchair users. This review documented a wide variety of systems and technologies, measuring a diverse range of outcomes. From the results, briefly reported in this paper, it was concluded that it would benefit the field to further understand what outcomes are important to measure and how. To address this gap we developed an online survey to query researchers and clinicians about which variables are most important when objectively documenting manual wheelchair use. We also wanted to explore the differences, if any, in the perspective of each of these two groups, depending on their context of practice. Finally, through the survey, we have documented some of the challenges and barriers researchers and clinicians may experiment when using data loggers with manual wheelchairs.

Methods

Scoping review – Five databases were searched: Medline, Compendex, CINAHL, EMBASE and Google Scholar. We limited our search to publication dates between January 1979 and June 2015. We excluded logging devices that were not suitable for wheelchairs and/or not mentioned to be so, were not fully described, were not suitable for use in the community, were only used for comparison and/or were not intended to continuously collect data. After publications relevant to the scoping review were identified, all significant data were recorded in a table developed for this study. These extracted data were reviewed by a rehabilitation engineering research technician and any discrepancies were resolved. Descriptive quantitative analyses were used to investigate the extracted data. Specifically, we calculated the frequency with which studies used each sensing technology and measured each outcome (i.e. mobility and physiological variables).

Survey – The scoping review previously done identified 23 categories of variables, used in the research studies. For the survey, we retained only 12 of these categories, those who represent at least 2% of the total outcomes measured. The online survey was sent to: 1) authors of the selected papers of our scoping review; and 2) other researchers and clinicians in the field of wheeled mobility who may have experience or interest in wheelchair data logging. Invitation to participate was also sent to listserves and groups such as Rehabilitation Engineering and Assistive Technology Society of North America (RESNA). Twenty-four survey questions asked about: 1) demographic information; 2) importance of the retained mobility and physiological variables on a scale that ranges from 0 to 10, where 0 indicates that the variable is not important at all and 10 indicates that the variable is extremely important. Participants were also asked to rank the importance of these variables from 1 to 12, where 1 represents the most important one and 12 the least important; and 3) some challenges/barriers in collecting these outcomes. The survey was launched June 1st 2015 and closed October 31 2015. Descriptive quantitative analyses were used to explore the collected data.

Results

Scoping review – A total of 119 papers were included in the scoping review. The papers documented a wide variety of logging devices and sensing technologies measuring a range of outcomes. A total of 91 different logging systems, comprising 217 sensing technologies, were described in the selected papers. Among the sensing technologies, 18.8% were accelerometers installed on the user, 12.4% were odometers installed on the wheelchair, 9.7% were accelerometers installed on the wheelchair and 9.7% were heart monitors. In terms of measured outcomes, the most reported ones were distance (10.9%), mobility events (10.4%), heart rate (9.7%), speed/velocity (9.0%), acceleration (8.1%) and driving time (6.2%).

Survey – Seventy-four persons, from different academic and professional backgrounds, answered the survey: 57 researchers (77.0%) and 17 clinicians (23.0%). Researchers had a mean years (SD) of research experience of 16.19 (9.73) and clinicians had a mean years (SD) of clinical experience of 17.88 (9.20). When participants were asked to rate the importance of the retained variables, “distance”, “mobility events” and “speed/velocity” were identified by researchers as most important (means of 7.47, 7.33 and 7.04, respectively), while “pressure-relief activities”, “seat pressure” and “distance” were identified by clinicians (means of 8.88, 7.94 and 7.94, respectively). Differences between the two groups (researchers and clinicians) were found for “pressure-relief activities” (researchers: mean=4.67, clinicians: mean=8.88), “seat pressure” (researchers: mean=5.29, clinicians: mean=7.94) and “acceleration” (researchers: mean=5.58, clinicians: mean=3.53). When ranking the variables, both researchers and clinicians identified “distance” as the most important variable (means of 3,67 and 3.19, respectively) and “body temperature” as the least important (means of 9.69 and 10.41, respectively). Differences between means were also found for “pressure-relief activities” (researchers: mean=7.53, clinicians: mean=3.47), “seat pressure” (researchers: mean=8.31, clinicians: mean=4.82) and “acceleration” (researchers: mean=6.28, clinicians: mean=9.19).

Participants were questioned about different possibilities to overcome some specific challenges or barriers encountered when using data loggers in their research or clinical practice: battery life, installation time, calibration time, data extraction, time to review information, cost and weight of the system. Refer to Table 1 for preferred options of researchers and clinicians.

Table 1. Preferred option to overcome challenges and barriers encountered

Challenges/ barriers	Researchers		Clinicians	
	Preferred option	%	Preferred option	%
Battery life	7 days	35.1	Up to 5 days	35.3
Installation time	20 minutes	47.3	5 minutes	76.5
Calibration time	5 minutes	64.9	1 minute	41.2
Data extraction	Requires local wireless	49.1	Requires physical connection	70.6
Scan of info	As long as it takes	36.8	5 min	41.2
Cost	$ 50-100	38.6	$ 50-100	29.4
Weight	100g to 500g	49.1	100g to 500g	58.8

Discussion and Conclusion

Data loggers have increasingly been used to provide innovative and quantitative documentation of wheelchair users' activities by recording a variety of outcome measures. Indeed, our findings showed a wide variety of systems and sensing technologies measuring a whole range of outcomes. As a first step to identifying which outcomes are most interesting to researchers and clinicians when attempting to objectively document manual wheelchair use, we have developed an online survey. The results demonstrate that although researchers and clinicians agree on the importance of some variables, distance for instance, they disagree on others. Especially, Differences were found regarding pressure-relief activities and seat pressure, whereby the clinicians attributed more importance to these variables than the researchers. In terms of challenges or barriers associated with the use of data loggers for monitoring manual wheelchair use, it appears that researchers and clinicians have relatively similar needs/preferences, except for the time they want or can allocate to review information. This may be related to the difference in the aims pursued. Our hope is that the collected survey data will help to further the development and increase the functionality of data loggers for manual wheelchairs, both for research and clinical contexts.

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1iv: Seat Elevators: How to Utilize the Functional Mobility Assessment to Track Function and Justify Medical Necessity

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Introduction

In July of 2011, the Inspector General issued a report stating Medicare payments for powered mobility increased from $259 million in 1999 to $1.2 billion in 2003. Policies were then revised to decrease spending to $658 million in 2007. Based on the Inspector General report, 61% of powered wheelchairs (PWC) provided to Medicare beneficiaries in 2007 were deemed medically unnecessary or had claims lacking sufficient documentation. This lead to increased scrutiny on medical documentation and justification for powered mobility and power seating functions[1].

According to the Rehabilitation Engineering and Assistive Technology Society of North America (RESNA) Position on the Application of Seat-Elevating Devices for Wheelchair Users, seat elevators (SE) are medically necessary for completion of Mobility Related Actives of Daily Living (MRADL's), specifically, to assist transfers in a downhill direction as well as sit to stand transfers, and to assist in reach for hygiene, meal preparation, parenting, and shopping. Use of SE may reduce upper extremity pain and overuse injuries with repetitive overhead reaching as well as compensate for upper extremity weakness and decreased range in motion. For psycho-social health, SE are recommended for eye to eye conversations to increase self confidence. Being at eye level may also decrease strain on the cervical spine[2].

Thus far, limited studies have been conducted on the use of SE. One study by Ding et. al. evaluated the usage of power seating options and reported average use of SE 4.3 +/- 4.5 times per day. Subjectively, participants reported SE were used to help reach objects at higher levels, transfer, work at different levels, shop, sit at a bar, turn on light switches, go the restroom, socialize, eat, read the calendar on the refrigerator, and reach elevator buttons[3]. No studies to date have evaluated how procurement of SE affects function, making justification and defense in appeals processes difficult when prescribing a SE.

The overall purpose of this study is to determine whether procurement of SE had an effect on overall function of the user. The first hypothesis is that at baseline, those with a SE would have higher functional mobility and transfer scores than those without a SE. The second hypothesis was that, at follow-up, a) those without SE who received them would have increased functional mobility and transfer scores and b) those with a SE who did not continue to use one would have decreased functional mobility and transfer scores.

Methods

Approval for this study was obtained from the Quality Improvement Subcommittee at the University of Pittsburgh. A retrospective analysis of a client data-base and medical chart review were conducted for individuals seen from 01/26/2012 to 05/08/2014 who were recommended to have SE during an evaluation at an academic assistive technology clinic. Demographics, procurement, functionality of the SE, and Functional Mobility Assessment (FMA) scores at baseline and follow-up were collected.

The FMA measures function with the use of various assistive technologies. This self-assessment is comprised of ten statements that evaluate the ability to carry out daily activates, comfort, health, operation, reach, transfer, personal care, indoor mobility, outdoor mobility, and transportation. These items are scored on a 1-6 point Likert scale, with a score of 1 meaning “completely disagree” and 6 meaning “completely agree.” Not applicable is scored as 0. Thus, a score range of 0 to 60 is possible. In 2013 Kumar et. al. demonstrated in a pilot study that the test-retest reliability had an interclass correlation for all FMA items of 0.87 with confidence interval of 0.85-0.89[4].

Alpha levels were set at 0.05, a priori, Statistical Package for the Social Sciences (SPSS, Inc., Chicago, Illinois, U.S.) 17.0, 18.0, and 20.0 were used for data analysis. Individuals were divided into two groups; those without SE at baseline, and those with SE at baseline. These two groups were compared with respect to outcome variables using t-tests (age and baseline FMA total score), Mann-Whitney tests (baseline transfer score on FMA subscale), and chi-square test (gender).

Individuals with follow-up data were split into 4 groups; those without SE who received them, those with SE who continued to use them, those without SE who did not receive them, and those with SE who did not continue to use them. Each group was evaluated for differences in total FMA and transfer subscale score between time points using Wilcoxon Rank Sum.

Results

A total of 61 records were reviewed. The mean age of clients seen was 52.8 years (SD 17.1), and 33 individuals (54.1%) were female. Age range was from 12 to 88 years. Mean FMA score at baseline was 41.4 (SD 13.6).

Of the total group, 36 individuals (59.0%) did not have a SE at baseline and 25 individuals (41.0%) had a SE at baseline. Those who had a SE at baseline had a significantly higher baseline total FMA score (p=0.002) and baseline transfer score on the FMA (p=0.034) than those who did not have a SE at baseline.

Of the 26 (42.6%) individuals who did not have a SE at baseline and received one, 8 had sufficient data to compare between time points. Total FMA score after receiving the SE was significantly improved (p=0.034). There was a trend for an improvement with transfer subscale score but this was not statistically significant. All 26 of these SE were approved through insurance.

Of the 17 (27.9%) who already had a SE and continued to use one, 9 had sufficient data to compare between time points. After continuing to use the SE over time, total FMA score significantly increased from baseline (p=0.016). There was a trend for an improvement on the transfer subscale score, but this was not statistically significant. Of the 17, 8 clients received new PWC with SE. Of those 8, 6 were approved by insurance, 1 was obtained via private appeal, and 1 was covered by the Pennsylvania State Office of Vocational Rehabilitation (OVR). The SE obtained via private appeal and the SE that was denied by insurance and then covered by OVR were denied because the SE were considered “non-covered items” by the insurer. The remaining 9 clients were pending a new power wheelchair and using an old PWC with a functional SE at the time of the analysis.

Of the 8 (13.1%) individuals who did not have a SE at baseline and did not receive one, only 1 had sufficient data. Therefore comparisons were not possible for this group. Of the 8, 3 are pending approval and 5 were denied at the time of the analysis. Of the 5 that were denied, 3 were considered by the insurer as “non- covered options items”, 1 was denied because of “insufficient justification,” and 1 was denied but no reasons were identified in the documentation. Of the denials, none were appealed.

Of the 10 (16.4%) who had a SE but did not continue to use them, 5 had sufficient data between time points. The total FMA scores after discontinuing use of the SE did not change significantly. However, the transfer subscale score on the FMA significantly decreased after SE was no longer available ($p=0.046$). Of the 10, 2 were in disrepair, 1 was in disrepair with a replacement pending authorization, and 7 were in disrepair with the replacement PWC denied. Of the 7 that were denied, 5 were considered “non-covered items” by the insurer, 1 was deemed not medically necessary, and 1 was both considered a “non-covered item” and deemed not medically necessary by the insurer.

Discussion

These findings support that PWC with SE are associated with improved mobility for those receiving one for the first time and with sustainment of level of mobility for those who replace and continue to use them. Once the SE is removed, a decrease in transfer ability is seen. The denial rate of SE overall in this study was about 20%.

Two limitations to this study deserve discussion. One limitation is small subject number which limits external validity and data available for some analyses. The second limitation is that the FMA is a self-assessment scale that is subject to user opinion.

This is the first study of its kind and work is ongoing to collect data from a larger cohort from our clinic as well as from a national sample. There is a push to include FMA as part of the electronic health record and as part of a Uniform Data Set for assistive technology outcomes. Overall, this ongoing data collection of additional variables such as diagnosis, insurer, and other variables will allow us to analyze trends in procurement of SE.

Conclusion

This study provides evidence to support the initial prescription, repair, and replacement of SE for appropriate individuals. Since authorization for powered mobility is becoming harder to obtain, appropriate documentation citing evidence as well as use of a reliable and valid outcome measure is recommended. This study supports that the FMA is a promising tool to measure function.

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1v: The Biomechanics of Using a SmartDrive

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Introduction
The SmartDrive™ is a relatively new power mobility add-on for manual wheelchairs. Although it might be anticipated that SmartDrive would produce similar benefits as other power add-on devices for manual wheelchairs, the SmartDrive™'s lighter weight and unique design warrants specific attention. For the indoor mode of the device, the person must provide sufficient acceleration applied to the handrims to trigger the motor to start. The degree the motor provides power is dependent upon how much force the person provides on that first push. For stopping their wheelchair, the person must stop their chair by grabbing the handrims. This braking force or deceleration triggers the motor in the device to stop. Clinically, it has been observed that some wheelchair users cannot start the device, or more problematically, may have difficulty stopping it.

Therefore, a study was conducted to compare the force required to start and stop a wheelchair with and without a SmartDrive™ at different speeds. Additionally, the stopping distance and peak total force after a single push were measured. It was hypothesized that it would take a greater total force to start and stop a wheelchair with the SmartDrive™ attached.

Methods
The study used a cross-over study design, in which participants were evaluated with and without the SmartDriveMX+. Participants were abled bodied individuals over 18 years of age, ambulatory, without any upper/lower extremity physical or neurologic problem and English speaking. Participants wheeled on a treadmill at two speeds (3.5 and 6km/hr). The researcher then asked the participant to stop the wheelchair while simultaneously turning off the treadmill. Stopping distance data were collected. For starting peak total forces and peak speed, participants were asked to push the chair at three different intensities (soft, medium and hard pushes) from stationary on a level tile floor with and without the SmartDrive™. Forces were normalized for body weight (%BW). Repeated measures ANOVA (RM-ANOVA) analysis was used to analyze the starting total force, stopping peak total force and stopping distances

Results
For the 24 participants (12M;12F), the stopping distances at both 3.5 km/hr and 6 km/hr were significantly shorter with the SmartDrive™ attached ($F=4.355$, $p=0.049$). The analyses showed no differences in stopping peak total force required for both speeds, when using the SmartDrive™ ($F=0.45$, $p=0.51$). The peak starting forces showed participants used significantly greater force with the SmartDrive™ attached ($F=4.57$, $p=0.04$).

Discussion

It was anticipated greater force would be required to stop the SmartDrive™ due to the added weight of the drive, however this did not seem to be the case as no differences in force between the two conditions were found. However, using the same force, participants were able to stop in significantly less distance (~3cm). This may be due to the inertia and rolling resistance of the drive wheel. Studies comparing the rolling resistance of five different wheels for manual wheelchairs, (i.e., three pneumatic (air filled) tires and two solid tires[1]) have shown that the pneumatic tires have significantly reduced rolling resistance compared to the solid tires. Similarly, a study by Kwarciak et al.[2] showed that pneumatic tires exhibited significantly lower rolling resistances and showed smaller increases in rolling resistances with added mass (45.4kg, 68.0kg, 90.7kg) compared to solid tires. Given that the SmartDrive™ wheel is solid and knobby, this could add rolling resistance to the wheelchair, increasing the chair's drag and contributing to the shorter stopping distance. This increased rolling resistance probably plays a role in the increased force required to start the motor.

Once the SmartDrive™ is engaged and the user is moving, only steering is required rather than repetitive strokes used for typical manual propulsion. However, the SmartDrive™ could potentially be fatiguing if it is frequently being engaged and disengaged (e.g. manoeuvring in small spaces). The added weight and drag may result in increased work under these circumstances.

Conclusion

This is the first study to determine forces required to use a SmartDrive™. It may be designed to reduce fatigue for wheeling longer distances with minimal interruptions. However for stopping and starting activities it can be stopped quickly but requires more force than without a SmartDrive™ to get it initiated. Thus, it may not show great benefits for mobility in tighter spaces. More research is needed to examine the benefits of wheelchair users in more real world environments.

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2i: Different Seats Impact on Spinal Cord Injury (SCI) Subjects and Effectiveness of Pelvic Total Support: A Multicentric Study

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I Rosaria E.Caforio have an affiliation with a medical device organization during the past two calendar years. The organization ‘s name is Pro Medicare Srl based in Italy. I am the managing director of the company and I have ownership interest in it, also I am part of the ownership and inventor of a patent submission for the product referred to in the presentation and marked by Pro Medicare Srl.

Summary
Spinal Cord Injuries subjects perform their daily living activities using wheelchairs and are continuously exposed to the risk of pressure ulcers and deformities process. Different cushions and seating systems are used to prevention scope and selected for their benefits, the main including Comfort, Stability, Functionality.

Effectiveness arising using different technologies is not always proven during the assessment process and results are often different by the desired ones. Furthermore there is evidence that the prevention not is given only by material or technology of cushions but from the relational trinomial composed by gravity force, postural alignment and supporting surface. The relational trinomial, needs to be considered during clinical practice through the exhaustive analysis of each assessment process.

Aims And Objectives
Aim of this industrial and clinical work is to select the optimal criteria to choose the right seat technology/material to prevent pressure sores and allow better functional performances as well as evaluate effectiveness of the PTS (Pelvic Total Support) new technology/material combination.

Introduction
It was analyzed the Pro Medicare Inserto seat technology based on a modular kit composed by flat base of construction, several inserts and a polymeric foams combination padding system to build a Pelvic Total Support. During the three different steps of the study the cushions design and material combination were optimized.

Study Design
This three steps study started in 2013 and concluded in 2015 and was made under the authorization of CNOPUS (National Coordination Professional Operators of Spinal Units) in Italy and was conducted in the Occupational Therapy Departments of five Spinal Units together with Pro Medicare development department. The first step of the study was conducted at Centro Paraplegici in Ostia, the second step at Centro Paraplegici in Ostia and at Unità Spinali Unipolari in Rome and Milan, the third step at Centro Paraplegici in Ostia and at Unità Spinali Unipolari in Rome, Milan, Turin and Catania.

First Step/Experimental Analysis

Participants were divided in two groups: in the first group were included five able-bodied subjects, in the second group five Spinal Cord Injuries subjects; written informed consent was obtained.

Materials used were: Two wheelchairs in different sizes of the same model, two wood bases to rigidify the seat and the back surfaces in two different sizes, two groups of cushions A and B divided in three sub groups (different technologies and materials) (Tab.1):

Group A (pressure relieve)			Group B (postural)		
A1	Air	Roho 6 LP	B1	Air	Roho Quadtro
A2	Polymeric/fluid	Jay Xtreme	B2	Polymeric/fluid	Jay 2
A3	Polymeric combined	Inserto Modo	B3	Polymeric combined	Inserto Novo

Tab.1: Cushion's groups

One surface EMG with wireless sensors 8 channels mod. Free EMG BTS, a gait analysis instrumentation with 6 synchronized infrared cameras with sample frequency 250 Hz and 2 video-cameras mod. El.I.Te.Smart Dx BTS, a pressure mapping system NOVEL PLIANCE (a flexible measuring mat, a multi-channel analyzer, a calibration device and a software package for PC's), standard ISO 16840-1:2006 "Vocabulary, reference axis convention and measures for body segments, posture and postural support surface", a data sheet for participants data detection, and a not standardized test to evaluate the perception of comfort and stability.

Three observation moments were established T0, T1 (15 minutes by T0) and T2 (30 minutes by T0) for the statics and dynamics moments, during the dynamic moment the subjects propelled for 4 times long 10 meters (total distance 40 meters, total sitting time for subject on each cushion 45 minutes).

Using the ISO 16840-1:2006 a protocol was established to standardize the biomechanical data recording process for wheelchair seated persons. At the beginning all data were collected for whole the sample using the wheelchair with wood basis for seat and back mounted to reach the seated reference position (90°beetwen trunk and pelvis, femur and tibia and leg and foot).

Data recorded were:

- Biomechanics: three absolute angles of body segments (α frontal pelvic angle, β sagittal pelvic angle and γ sagittal trunk angle);
- Interface pressure mapping: mean pressures, mean areas, mean forces were detected from Novel Pliance during the three times both for static and dynamic, and a relative importance [2-3] was given due the influence of the different cushion's design, the relationship with mat surface, the morphology of the subject and the relationship man/sitting surface/material's properties/ wheelchair's configuration.
- Emg: to analyze the muscular activity and muscular coordination (m.gluteus, m.rectus abdominis, m.erector spine, m.tricepts);

- Questionnaire: to detect the comfort and stability perception fixing a numeric score between 0 (lowest) and 5 (highest)

Results: A contoured design of the cushion including the pelvic total support, whatever the technology of the material, involves a balance between the stability of the pelvis and of the trunk improving the coordination of movement, minimizing and/or inhibiting pelvic instability on frontal and sagittal planes. The design of the cushion builds a proximal support (anterior-posterior and lateral of the pelvis) improving the manual ability and faciliting the sitting position during the time and the related activities also, making it more safe, effective, economical and comfortable. The choice of the different technologies of the materials in combination with the design, shows that, with the several variables (time, pressure, force and area), the materials must have the property to adjust their self continuously during the activity, not only to prevent the UDP but to prevent the deformity process also.

Second Step/Development

Partcipants were sixteen Spinal Cord Injuries subjects; written informed consent was obtained. Inclusion criteria were; One year minimum from injuries, minimum age 25 years old, no pressure sores present, no trunk corset used, moderate trunk control.

Materials used were: Wheelchair already used by subjects with same customization, cushion already used by subjects, Inserto Modo and Inserto Novo cushions with custom adaptation to each participant (at this step design and material combinations of cushions were optimized), ISO standard 16840-1:2006 “Vocabulary, reference axis convention and measures for body segments, posture and postural support surface”, a data sheet for participants data detection, pictures to observe skin redness, a not standardized test to evaluate the perception of comfort and stability and a data sheet to detect results to perform functional activity exercises.

Three observation moments were established T0, T1 (45 minutes by T0) and T2 (90 minutes by T1), total sitting time for each cushion 135 minutes. During the sitting time subjects performed their activities freely.

Data recorded : At T0 the following data were recorded; spinal cord injury level, subjects personal data, measures for body segments, weight, cushions used, wheelchair used, presence of postural deviations, skin redness. At T1 the following data were recorded; postural modifications and skin redness presence. If redness present disappearing time was detected. At the end of T2 each participant performed functional activity exercises and skin redness presence. If skin redness present disappearing time was detected.

Results: A Pelvic Total Support seating surface, accommodates the pelvis distributing uniformly loads, pressures and forces. Comfort and Stability perception given by the optimized cushions design and material combination do not differ from cushions already used by participants. Quadriplegic subjects had highest stability perception with a cushion more customizable and designed with an higher posterior pelvic control (Inserto Novo). Paraplegic subjects had better comfort and stability perception with a cushion less customizable (Inserto Modo). The chosen cushion has to improve functional performances during activity daily living.

Third Step/Conclusion

Participants were thirteen Spinal Cord Injuries subjects; written informed consent was obtained. Inclusion criteria were the same as for the second step study.

Materials used were the same as for the second step study, as well as methods and data recorded.

Results: The results of the second step/development were confirmed.

Conclusions
Conclusive design optimization was made to Inserto Modo and Inserto Novo cushions. In particular Inserto Modo cushion has been made minimally customizable to allow better options in the sagittal alignment of subjects. These options resulted very important during assessment process also, in the case of a cushion with size length different from subject anthropometric sizes.

Inserto Novo cushion appears to be more appropriate to accommodate and align the pelvis as well as to stabilize the trunk. The particular design of this last cushion in the posterior part allows to cover up the lack of adiposity if this occurs, adhering to the shapes and balancing the loads.

Both cushions have not caused important skin redness, their performances related to pressure sore risks are comparable to other cushions widely used.

The analyzed technology accommodates the whole pelvis anatomy, facilitates the assessment process and the identification of the right seat configuration for the client, also can be modified time to time when some client modification occur. The combination of different polymeric material in the structure and in the padding system is comparable in the outcomes to other technology widely used.

Discussion
During the study there was evidence that the assessment process has to be careful as well as methodology has to be accurate not only regarding the sitting surface but regarding all the relationship system client/sitting surface/wheelchair; all this relationship system needs to be accurately personalized.

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2ii: Influence of Sacral Sitting in a Wheelchair on the Distribution of Contact Pressure on the Buttocks and Back and Shear Force on the Ischial Area of Wheelchair Users

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Introduction

Sacral sitting is a seated posture with pelvic posterior tilt and thoracic kyphosis, and it is a typical poor posture observed in frail elderly adults using a wheelchair[1]. Sacral sitting by frail elderly adults occurs when their ability to retain a seated posture has decreased, and their body size and function do not match the size and structure of the wheelchair [2]. In addition to the problem of the size of the standard wheelchair, widely used in hospitals and elderly care facilities, not being suitable for individual wheelchair users [3], there are structural problems that make it difficult to maintain a seated posture, such as the hammocking effect of sling seats and poor back support [2], which are likely to induce sacral sitting. Frail elderly adults, in elderly care facilities, sit in a wheelchair with a poor seated posture, including sacral sitting, for long periods during the daytime [4]. It has been reported that sacral sitting with pelvic posterior tilt increases the risk of pressure ulcers on the buttocks in frail elderly adults [5, 6]. A pressure ulcer is a localized injury caused by contact pressure or pressure in combination with shear force on the skin and/or subcutaneous tissue on a bony prominence [7]. The vertical and horizontal forces loaded on the sacrococcygeal region in a seated posture increase with an increase in pelvic posterior inclination angle [8]. However, the influence of sacral sitting on contact pressure and shear force loaded on the buttocks while seated in a wheelchair has not been clarified.

In this study, pelvic inclination angle, contact pressures on the buttocks and back, and shear force were quantitatively measured while healthy subjects adopted sacral sitting in a wheelchair to investigate the influence of sacral sitting on contact pressure and shear force loaded on the buttocks.

Subjects and Methods

The subjects were 26 healthy adults (5 males, 21 females; mean age, 21.0±0.9 years). Measurement was performed using a modular wheelchair (Revo Next; ETAC Co., Ltd.), each part of which is adjustable for the body sizes of users. On measurement, it was adjusted for the body size of each subject, with a wheelchair cushion (Type 5 TC-045; Takano Heartworks Co., Ltd.) placed on its seat. The subjects assumed 2 postures: sitting up straight with the buttocks placed far back on the wheelchair seat as a basic seated posture, and sacral sitting with pelvic posterior tilt and the ischium slid forward by 5 cm compared to the basic seated posture. The distance of forward movement of the ischium was measured using a 30-cm steel carpenter’s square ruler.

To measure the distance, the end of the ruler was placed against the lower edge of the patella of the subject, while the ruler was held parallel to the thigh in a horizontal position. The distance from the patellar end to the point where the ruler and the front of the seat met was determined to be the distance of forward movement of the ischium [9, 10]. In each posture, the inclination angle of the sagittal pelvic line, contact pressure on the ischial region, maximum contact pressures on areas of the buttocks and back, and shear force generated by sliding the ischial area forward were measured. The inclination angle of the pelvic sagittal line was measured using an inclination angle-measuring device, HORIZON (Yuki Trading Co., Ltd.), which is a seated posture-measuring device in accordance with the ISO16840-1 standard. When the sagittal pelvic line tilted backwards from the vertical line with a posterior pelvic tilt, values measured with HORIZON became negative. In contrast, when the sagittal pelvic line tilted forward from the vertical line with an anterior pelvic tilt, they became positive. Contact pressures on areas of the buttocks and back were measured using SR Soft Vision (Fukoku Busssan Co., Ltd.), which was placed on the wheelchair cushion. SR Soft Vision is a seat-type sensor pad with 256 pressure-sensing points indicating the loaded pressure on each point. The number of responding sensing points was regarded as the size of the contact area. Shear force generated by sliding the ischial region forward was measured using Predia (Molten Co., Ltd.), which was placed on the wheelchair cushion.

For analysis of the representative measured values between the 2 postures, a paired t–test was employed when the measured values showed a normal distribution, and the Wilcoxon signed-ranks test when the distribution was not normal.

The Medical Ethics Committee of Gunma University approved this study (26–43), and written informed consent was obtained from all subjects.

Results

Posterior pelvic tilt was significantly greater in sacral sitting ($p<0.001$). Maximum contact pressure on the buttocks ($p<0.001$) and contact pressure on the ischial region ($p<0.001$) significantly decreased in sacral sitting, whereas maximum contact pressure on the back ($p<0.001$), contact area of the buttocks ($p<0.001$), contact area of the back ($p<0.001$), and shear force generated by sliding the ischial region forward ($p=0.003$) significantly increased.

Discussion

In sacral sitting, pelvic posterior tilt increased compared to that in basic sitting, and maximum contact pressure on the buttocks, and contact pressure on the ischial region decreased, whereas maximum contact pressure on the back, contact areas of the buttocks and back, and shear force generated by sliding the ischial region forward significantly increased.

The trunk inclines backward with pelvic posterior tilt, and the combined center of gravity of the head, arms, and trunk shifts backward. Since pelvic posterior tilt was greater in sacral sitting than in a basic seated posture, the combined center of gravity of the head, arms, and trunk may have shifted backward compared to that in basic sitting and resulted in increases in the force pressing the subjects' back to the back support in sacral sitting and maximum contact pressure on areas of the back, compared to those in basic sitting. It was assumed that weight-bearing on the wheelchair seat supporting the buttocks decreased as the combined center of gravity shifted backward in sacral sitting, with which load on the back support increased, maximum contact pressure on the buttocks decreased, and that on the back increased. A previous study also reported that maximum contact pressure on the buttocks decreased and that on the back increased in a posture with posterior pelvic tilt[11]. The act of pressing the trunk against the back support produces a counterforce that shifts the buttocks forward[12]. The back support converts backward angular momentum of the trunk produced by posterior pelvic tilt to shear force in the forward direction[13,14]. In this study, posterior pelvic tilt markedly increased in sacral sitting compared to that in basic sitting, which may have increased the force pressing the trunk against the back support and shear force generated by sliding the ischial region forward, compared to those in basic sitting.

To prevent pressure ulcers, maintenance of proper posture and postural control, and providing a support surface appropriate for individual needs to reduce contact pressure and shear force are recommended[7]. The results of this study indicate that shear force loaded on the ischial region increases with an increase in posterior pelvic tilt in sacral sitting. When frail elderly adults adopt sacral sitting, shear force by sliding the ischial region forward increases with an increase in posterior pelvic tilt, which may increase the risk of pressure ulcers in the ischial region. Medical professionals involved in wheelchair seating should improve the situation regarding the sacral sitting of frail elderly adults and support the maintenance of appropriate posture and postural control to reduce the risk of pressure ulcers in the ischial region.

Conclusion

In sacral sitting, pelvic posterior tilt increased compared to that in basic sitting, and maximum contact pressure on the buttocks and contact pressure on the ischial region decreased, whereas maximum contact pressure on the back, contact areas of the buttocks and back, and shear force generated by sliding the ischial region forward significantly increased.

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2iii: A New Approach to Pressure, Friction, Shear and Microclimate Management in Wheelchair Seating – Imagine the Possibilities

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I, (Mark Payette) have an affiliation with Tamarack Habilitation Technologies, Inc. as an employee with involvement in product research.

This presentation is a report to show progress made in designing and developing a radically new wheelchair seat design. The design goals include the management of all of the local pressure ulcer generation factors and a new process for producing a custom-formed seat surface which can be done rapidly, and with the immediate and direct input and control of seating team personnel (supplier, clinicians, and consumer) at the provision site and time.

The National Pressure Ulcer Advisory Panel recognizes four physical conditions at these ulcer sites which contribute to tissue trauma and which relate to seat materials and design. They are 1. Pressure; 2. Friction with its associated shear forces; 3. Heat; and 4. Moisture.[1] The wheelchair seat support surface (cushion) is under development, and addresses and minimizes all four of these local factors.

The Pressure Factor
When contact pressure is too great, usually in a bony area, blood cannot flow through the capillaries sufficiently to bring oxygen and nutrients to the cells and metabolic byproducts are not carried away. If that high contact pressure persists too long, the cells begin to die.[1, 2] Until very recently, the pressure-induced ischemia model of ulcer generation has exclusively dominated the design of wheelchair seat cushion and other body support surface products to the near-exclusion of the other three tissue trauma factors.

The Friction Factor
The second factor on the list, and perhaps the most destructive, is friction and the elevated shear stresses it causes. Friction at the skin surface causes shear stress and strain (deformation) within the skin and soft tissues. Shear strain can be very destructive.[3, 4] In fact, Bennet, et. al. detected capillary occlusion at greatly reduced pressure (approximately 50%) when shear loads are superimposed. There is also evidence that the friction-induced shear stress caused by short duration friction loading causes direct fracturing of sub-dermal biological micro-structures.[2]

There is a common misconception that friction loads can only cause surface damage such as abrasion and dermal blisters. However, friction loads at the skin surface do result in shear stress and strain changes at deeper levels.[1, 2, 3, 5, 6]

A second misconception is that friction loads and their damaging effects occur only as the wheelchair user (or person in bed) is moving or being moved. Actually, very damaging levels of residual friction-induced shear distortion persist after a person settles into their wheelchair or bed.

Micro-movements occurring during subtle positioning changes and functional activities add to the residual friction while sitting or lying and increases damage over time. It is known that tissues at bony areas are at very high risk because that is where the enabling pressure and shear strain magnitude will be greatest.[3, 4]

Scar tissue must also be recognized as especially vulnerable to shear damage. Friction loads and shear stresses will concentrate at a scar because it is less elastic than surrounding tissue. When scar tissue is accompanied by adhesions to underlying tissue or bone, the risk of re-injury is even higher.[7] This is a likely reason for the high pressure ulcer recurrence rates.

The Microclimate Factors

Heat/temperature comes in as a pressure ulcer-generating factor because a one degree Centigrade rise in temperature will increase cell metabolic rate by approximately 10%.[1,8] The temperature of the skin also impacts the strength of the stratum corneum - at 35 degree C the mechanical strength of the stratum corneum is 25% of skin at 30 degrees C.[1, 9]

Moisture is the last on the list of the four local physical factors in ulcer generation. The outermost layer of skin, the Corneum, is physically weaker when moist. The Corneum, like many other materials, exhibits a higher coefficient of friction (COF) when moist than when dry.[10] So, any support surface feature which enhances air circulation will carry a double benefit. It will help maintain epidermal integrity and the evaporative cooling will delay onset of tissue necrosis.

THE QUADRUPLE APPROACH; PULLING IT ALL TOGETHER

This unique new approach for a wheelchair seat support surface consists of a weight-bearing structure with a simple Tabby weave pattern of straps which are attached to a specialized frame. During the forming process, the length of each strap is controlled by its own individual mechanical device. The frame provides a firm area of support under the thighs.

The perimeter of the posterior section of the frame is contoured to provide clearances for bony areas (the Sacrum and Greater Trochanters). The woven straps crossing the sub-pelvic area are suspended from the perimeter of the frame in a way which allows each strap to lengthen individually as needed in response to downward pressure. This allows the woven surface to assume the contours of any individual pelvis. Beyond that, the design allows a trained provider to easily lengthen two or more intersecting straps to reduce or remove weight-bearing loads from any wounded or at-risk areas. During the custom forming process, the use of a pressure mapping mat is helpful. Since the undersides of the woven straps are exposed and palpable, a knowledgeable provider can easily palpate, without forcing a hand between the straps and the user's underside, to identify areas requiring additional pressure relief and to make those changes while the patient remains seated, undisturbed. When the provider has made any necessary adjustments, the "pay-out" ends of the straps are firmly anchored to the frame and the "pay-out" hardware is removed for re-use by the ATP.[11]

The seat support surface (cushion) design is completed by a novel two piece fabric cover assembly. The surface of the upper (outer) cover is divided into two very contrasting friction zones; the area beneath the pelvic boney anatomy provides a very low friction zone, the entire thigh area retains a relatively "normal" high friction zone. The sub-pelvic area of the cover is made of a patented low-friction composite material panel exhibiting an ultra-low COF of less than 0.2. The low-friction interface area under the pelvis effectively isolates those at-risk sites from damaging levels of friction-induced shear. In addition, that material is air-and-liquid permeable, helping to reduce temperature and moisture levels for very favorable microclimate conditions. This low-friction interface technology is called GlideWear®.

The lower, second cushion cover component, is made of a reticulated spacer fabric. The open nature of the spacer fabric and strap gaps allows air access for drying and cooling. Bench testing results performed at an independent test lab show this new design to be capable of significantly improving the microclimate factors of temperature and moisture. (Table 1) Plans are in place for a study at the Minneapolis VA to investigate this new technology's microclimate performance with human subjects in 2016.

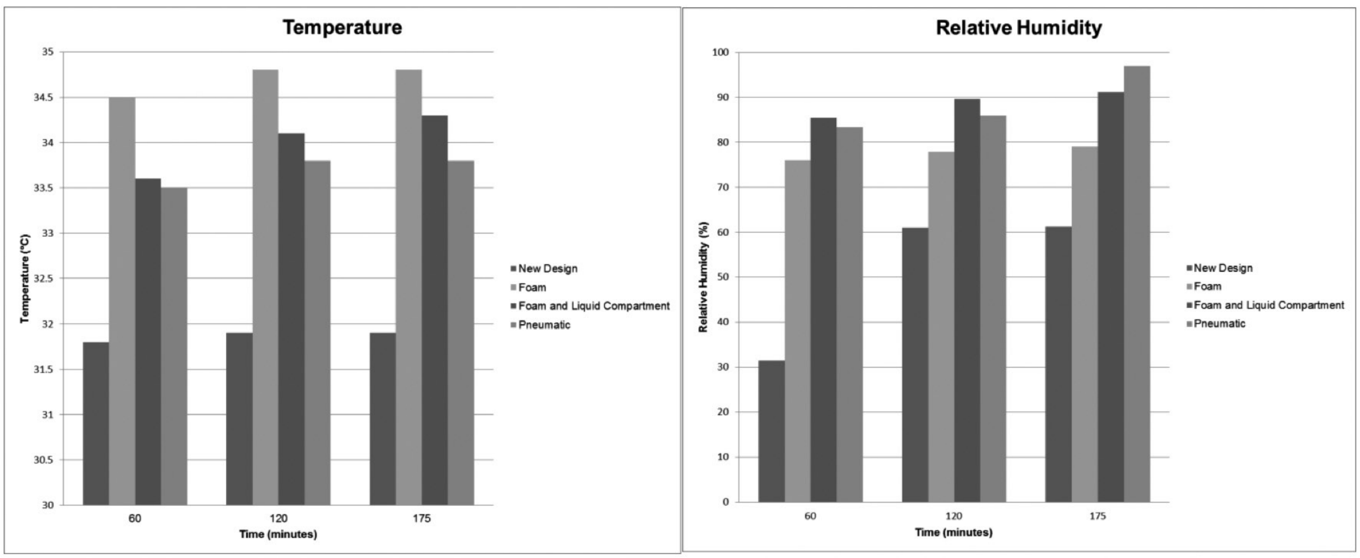

Table 1. Heat and Water Vapor test data [12]

The wheelchair seating technology just described can be adapted to be an independent cushion or it may be integrated directly into the wheelchair frame design. An integrated approach reduces total equipment weight and eliminates one mobility system component.

Currently there are a small number of individuals Beta testing this design successfully, with use beginning in 2013. As of December 2015 n=8. The manufacturer envisions further evaluations, mostly in the greater Minneapolis area, esp. at the Minneapolis VA, across 2016. (Table 2)

User	DX	Reason for Use	Time in use	Outcome	Acceptance	Functional Issues
1	SCI-para	multiple, severe, non healing wounds	40 months	wounds closed - wounds improved	easy and fast	none
2	SCI-para	severe pain and discomfort	18 months	pain free comfortable	easy and fast	none
3	SCI-para	wound prevention and stability	6 months	wound remaining closed and is stable	easy and fast	transfers more difficult
4	SCI-quad	discomfort	5 months	comfortable	easy and fast	none
5	SCI-para	wound and unilateral hip ext contractur	5 months	wound closed and contracture accomodated	easy and fast	none
6	SCI-para	posture, pain and comfort	4 months	improved posture, pain relief and comfortable	easy and fast	transfers more difficult
7	SCI-para	wound, discomfort	2 months	wound closing comfortable	easy and fast	transfers more difficult
8	SCI-para	wound	1 month	wound closing	easy and fast	none

Table 2 Beta Testing User Feedback Tamarack Habilitation Technologies, Inc.

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2iv: Heat Dissipation in a Custom Molded Seating System

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Purpose
To validate a strategy for heat dissipation for clients using custom molded foam seating systems.

Summary
Poured foam seating systems are frequently used for clients with complex seating needs. While postural control goals may be met, users/caretakers frequently observe that clients feel "sweaty" and "overheated". On rare occasions, caregivers are concerned that this heat build-up contributes to medical problems, including increased seizure activity, dehydration, and skin irritation/breakdown.

Custom molded seating aims to maximize surface contact in order to dissipate supporting forces and decrease areas of peak pressure. Such systems enclose posterior and lateral surfaces of the thighs, pelvis, and trunk. We assume that heat dissipation based on sweating is adversely impacted.

A review of the literature suggests that current research in temperature measurement and management in seats exists mainly within the commercial realm; peer reviewed studies are limited. Fard, et al. studied the correlation between high pressure readings and temperature change to identify pressure ulcer development. Megalingam, et. al. developed a wheeled patient monitoring system that included temperature measurement as a health paramenter. None of the research that we identified addressed heat dissipation for clients using custom molded seating systems.

Practice at our facility is to provide clients with spacer mesh fabric covers for some of their seating surfaces. Anecdotal reports from clients suggest that spacer mesh covers ease discomfort. We see a need to quantify the impact of this strategy to determine whether it is effective for heat and sweat management.

A test rig was fabricated consisting of a custom molded foam seating system for a neurologically normal child of 14 years age. She had no prior experience of custom seating. Her body temperature was increased in a sauna until the moment of discomfort (Pilch, et. al.). At this point, the subject donned clothing* if required and exited the sauna into a temperature controlled room (set at 23°C). Her body heat dissipation was measured using an oral thermometer in five separate scenarios. These scenarios were as follows:

1. Sitting on a stool with clothing*

2. In the postural control system, with clothing*

3. In the postural control system with clothing* and spacer mesh

4. In the postural control system with a bathing suit

5. Sitting on a stool in a bathing suit

* poly-cotton blend long-sleeved t-shirt & synthetic “soccer” trousers

The results were compared and analyzed.

Conclusion

In our test situation, the subject’s body temperature in a sauna consistently rose to levels above 37.8°C. Body heat dissipation was measured in one minute increments upon exiting the sauna. In all scenarios, during the first three minutes the subject’s oral temperature dropped steeply and then levelled out asymptotically towards a baseline temperature (which had been measured prior to entering the sauna, during the same session). At 30 minutes following the exit from the sauna the temperature readings were discontinued. In all cases, the temperature at 30 minutes was more than 0.5 degrees Celsius above baseline. Variations in heat dissipation could be discerned between the five separate scenarios. The most significant variations in the drop of body temperature occurred in the two scenarios where the test subject was wearing a bathing suit, rather than full clothing as described above.

These results lead us to conclude that heat dissipation of this subject’s body against the seating system was not significantly influenced by the spacer mesh. In relating these results to our client population, we could not validate the use of spacer mesh to manage heat in custom molded seating systems.

Further study will explore skin temperature measurement and options for temperature and moisture management in custom molded seating systems. We are also interested in looking at the relative role that clothing plays in heat dissipation and overall comfort.

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2v: Whole Body Vibration Measurement System for Power Wheelchairs

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Abstract
Vibration, shock (single event and repeated), and motion have a significant effect on the health and quality of life for individuals who utilize a wheelchair for mobility. The purpose of this study is to design and implement a methodology for characterizing whole-body vibration when an individual uses a power wheelchair. A power wheelchair with an anthropometric test device was instrumented with accelerometers and driven over a sub-set of the wheelchair skills test. The vibration-dose-value (VDV) and the seat effective amplitude transmissibility (SEAT) were calculated to characterize the vibration and shock. The VDV was largest for the back pan, followed by the chassis and the seat pan. The combined transmissibility was 77% for the chassis-seat system, and 277% for the chassis-back system. The VDV and SEAT demonstrate the ability to characterize the vibrations and shocks generated during power wheelchair mobility, and the transmissibility of the system.

Introduction
As of 2005, more than 3.26 million Americans have a disability that requires wheeled mobility equipment[1]. Vibration, shock (single event and repeated), and motion have a significant effect on the health and quality of life for individuals who utilize a wheelchair for mobility. Vibration and shock can cause back pain and injury, which has been well documented in the literature[2-4]. Based on consumer and clinician focus groups, there is a need to design and manufacture power wheelchairs (PWC) that minimize vibration, shock and motion in order to maximize function and minimize the likelihood of pain and injury[5]. The purpose of this study is to design and implement a methodology for characterizing whole-body vibration when an individual uses a PWC.

Methods
The foundation for instrumentation, data collection and data analysis of whole body vibration are based on ISO 2631-1[6] and the textbook "Human Response to Vibration"[4]. Modifications to the methodology were necessary in order to apply the procedures to an individual seated in a wheelchair. Accelerometers were placed on the chassis of an Invacare[A] TDX SP power wheelchair with Contoura seating, underneath the seat pan, and on the back pan (Figure 1). The accelerometers were mounted at the following locations: 1) the bottom-center of the seat pan; 2) the top-center of the back plate 55.5cm above the seat pan; and 3) the rear-center of the chassis frame 29 cm behind the axis of the middle wheel on the wheelchair transit brackets.

An attendant joystick was used to control the wheelchair as it was driven through a subset of activities from the Wheelchair Skills Test[7] correlations and comparisons were carried out using within-participant and subgroup comparisons. PARTICIPANTS: 58 manual wheelchair users, a sample of convenience. SETTING: Rehabilitation center. Intervention: The Wheelchair Propulsion Test (WPT at a speed of 0.88 m/s (2.0 mph). A 50th percentile male Hybrid III (midsize male) anthropomorphic test device (ATD) with a mass of 78.20 kg (172 lb.) was utilized (figure 1).

Figure 1: ATD in PWC with wheelchair skills test in the background.

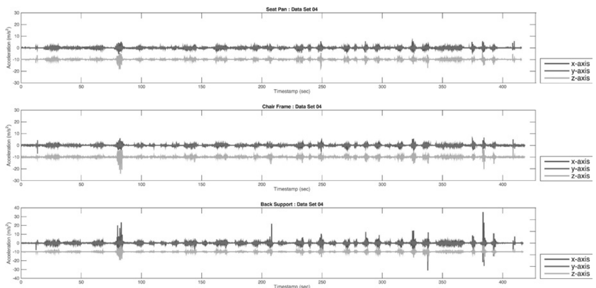

Figure 2. Accelerations measured at the seat pan (top), chassis (middle) and back pan (bottom).

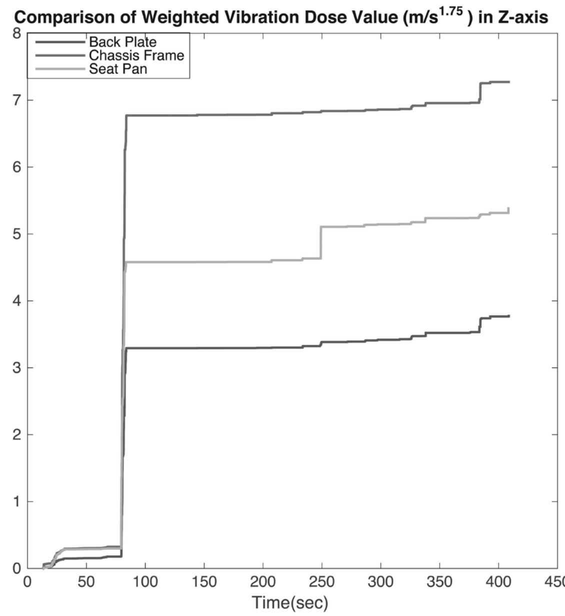

Figure 3. Weighted VDV for chassis (top), seat pan (middle), and back pan (bottom) in the z-direction (vertical).

The acceleration data was downloaded from the dataloggers and imported into Matlab[B] for data analysis. A sample set of data is displayed in figure 2. The data was weighted in accordance with ISO 2631-1. The effect of the weightings were verified by comparing the unweighted data to the weighted data.

The vibration-dose-value (VDV) was utilized to characterize whole-body-vibration. The VDV is measured in units of $m/s^{1.75}$ (or VDV) and expressed as:

$$VDV = \sqrt[4]{\int_0^T a_w^4(t)dt} \qquad [1]$$

where, *T* is the duration of the measurement, and *aw(t)* is the frequency weighted acceleration at time *t*. The VDV is the preferred method for representing magnitude for vibration signals similar to the ones collected in this study, which are characterized by shock based events (e.g. thresholds, curbs, pot holes).

The seat effective amplitude transmissibility (SEAT) value was used to characterize transmissibility[4]. The SEAT value is defined by the dimensionless ratio of ride (dis)comfort at the output location to ride (dis)comfort at the input location. For this study, ride (dis)comfort was represented by the VDV therefore SEAT is expressed by

$$SEAT\% = 100 * \frac{VDV_{output}}{VDV_{input}} \quad [2]$$

Results

An instrumented PWC with an ATD were run through a subset of the wheelchair skills test[7] correlations and comparisons were carried out using within-participant and subgroup comparisons. PARTICIPANTS: 58 manual wheelchair users, a sample of convenience. SETTING: Rehabilitation center. Intervention: The Wheelchair Propulsion Test (WPT. The VDV was calculated in each direction of a basicentric coordinate system, and the combined VDV were calculated for a single trial (Table 1). The transmissibility in each direction and the overall transmissibility were calculated for the seat pan and the back pan using the SEAT parameter (Table 1). For comparison of the VDV in each orthogonal direction, and comparison of the VDV at each location, the weighted VDV is displayed over time (figure 3).

Table 1: Characterization of the vibration via the VDV, and characterization of the transmissibility via the SEAT for a single trial.

	Chassis			Seat			Back		
	x	y	z	x	y	z	x	y	z
VDV ($m/s^{1.75}$)	3.25	2.06	7.27	3.69	1.58	5.38	20.34	4.36	3.78
VDV_{xyz} ($m/s^{1.75}$)		7.355			5.67			16.28	
SEAT%				113	76	74	626	212	52
Combined SEAT%					77			277	

Discussion

The VDV provides a measure of the whole-body vibration that an individual experiences when using a PWC. Furthermore, the SEAT provides a measure of the transmission of whole-body vibration. As anticipated the VDV steadily increases over time, and has a step increase as the power wheelchair experiences a shock event. Example activities that caused a shock event were traversing a set of multiple thresholds and a simulated pothole (figure 3). The effect of the multiple thresholds can be seen in figure 3 at ~80s , and the effects of the pot hole at ~380s.

The VDV is largest in the z-direction (vertical) for the chassis and seat pan (table 1 and figure 3), while largest in x-direction (forward-reverse) for the back pan (table 1), as was anticipated. Furthermore, the combined chassis-seat transmissibility as measured by the SEAT was 77% , while the chassis-back transmissibility was 277% (table 1). Values less than 100% indicate that the vibrations are attenuated, while values greater than 100% indicate that the vibrations are amplified. These results are consistent with the reports from consumers, as they feel like they are often thrown forward when traversing obstacles in real-world environments[5].

The purpose of this study was to describe a methodology for characterizing whole-body vibration and shock when an individual uses a PWC. Based on the results from a single trial, the VDV and SEAT demonstrate the ability to characterize the vibrations and shocks generated during

PWC mobility, as well as the system transmissibility. Future studies will use this information to characterize the transmission of whole-body vibration and shock based on the mechanical properties of the power wheelchair and the configuration of the power wheelchair components (e.g. suspension system). Clinically, limiting the transmission of shock and vibration is important for minimizing the likelihood of pain and injury, minimizing fatigue throughout the course of the day, and minimizing the individual's motion within the wheelchair in order to improve the control of the wheelchair. The primary limitation to the methodology described in this paper is the fact that it was developed for individuals without a disability in industrial applications.

Conclusion

The vibration-dose-value and the seat effective amplitude transmissibility demonstrate the ability to effectively characterize the shock and vibration characteristics of a power wheelchair when traversing obstacles typically seen in the community. The analysis of whole-body vibration is important to individuals who use power wheelchair in order to increase community mobility and decrease fatigue, pain and injury. In the future, the VDV and SEAT may be used by engineers to design more advanced power wheelchairs, and by clinicians/consumers to compare wheelchairs.

Manufacturers

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3i: Measurement Properties of the Wheelchair Skills Test for Scooters

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Introduction

The Wheelchair Skills Test (WST) is a fundamental part of the Wheelchair Skills Training Program.[1] The WST assesses ability to perform important community mobility skills. Originally, the measure was developed to assess manual wheelchair skills. It was expanded to include power mobility skills in 2005 and scooter skills in 2013. Objective (rater assessed) and subjective (self-report) versions of the WST have been developed.

The measurement properties of different versions of the WST have been evaluated in variety of studies. High test-retest reliability has been reported among manual[2-3] and power wheelchair users.[4] The objective and subjective versions of the measure have been shown to be highly correlated in manual and power wheelchair users (range: 0.61- 0.95).[5-8] Scores on the WST are negatively correlated with age and functional independence in manual wheelchair users[2] and positively associated with wheelchair skills confidence in manual and power wheelchair users.[4-8] Men have been found to have higher manual wheelchair skill scores than women.[2]

Several pre/post studies have evaluated the efficacy of training interventions on scooter driving skills; however, they did not use validated measures of scooter skills.[9] Problems with reliability may have potentially affected their ability to detect change. There is also a question about whether these measures included all of the skills that are relevant for community mobility.

Given the importance of using robust measures in practice and research, a study was undertaken to assess the reliability and construct validity of the objective WST-Sc.

Methods

Design: To assess test-retest reliability the WST-SC was administered to participants at baseline and again four weeks later. To assess construct validity we determined whether scores on the WST-Sc varied as anticipated with other measures and demographic variables.

Main Outcome Measures: The WST-Sc evaluated participants' capacity to perform 29 scooter skills objectively.[1] The WST-Sc Questionnaire (WST-Sc-Q) evaluated scooter skill capacity subjectively.[5-8] The physical environment sub-scale of the Wheelchair Use Confidence Scale was used to measure that aspect of scooter mobility self-efficacy.[10] Symptoms of anxiety and depression were measured using the Hospital Anxiety and Depression Scale.[11] Visual attention and task switching was measured using the Trail Making B task measured.[12] Functional independence was measured using the physical functioning subscale of a self-report version of the Functional Independence Measure.[13] Visual acuity was measured using the Snellen Eye Chart.[14]

Results

Twenty individuals who owned a scooter for a minimum of three months and were unable to ambulate more than one city block without a mobility aid took part in the study. They had a mean age of 63 years and half were female.

The four-week test-retest intraclass correlation coefficient for the WST-Sc was very high. Scores on the WST-Sc were moderately correlated with scooter confidence, WST-Sc-Q scores, and functional independence. Men scored significantly better than women.

Conclusion

The measurement properties of the measure are in keeping with previous research on other versions of the WST. The reliability estimates are very similar to those found among manual wheelchair users.[2-3] Scores on the measure generally varied as anticipated with demographic variables and scores on other measures. This research provides preliminary support for the use of the tool in research and clinical practice, but further research is needed to look at its responsiveness.

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3ii: Get in the Game: Gaming technology for wheelchair skills training

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I, Ed Giesbrecht, do not have an affiliation (financial or otherwise) with an equipment, medical device or communications organization. Speakers who have no involvement with industry should inform the audience that they cannot identify any conflict of interest.

Introduction

A manual wheelchair (MWC) can provide considerable benefit to individuals with mobility impairments, such as increasing function and participation in important activities as well as decreasing assistance and caregiver burden.[1] However, procuring a wheelchair without also acquiring the prerequisite skills for optimal operation can negatively impact the benefits of this technology. Accordingly, the World Health Organization has advocated for skills training as an essential component of the wheelchair acquisition process.[2] Providing such training is not without its challenges, however. Clinicians have a limited amount of time to spend with their clients and are often unable to prioritize extended training and practice sessions.[3] Motor learning theory indicate that developing proficiency with motor skills, such as wheelchair mobility, requires considerable repetition and refinement. Practicing wheelchair skills can become rather tedious for wheelchair users and they may not achieve sufficient repetition for optimal gains in performance. This is particularly relevant for individuals with greater impairment (e.g. reduced strength, coordination, endurance), and those with lower confidence or motivation, who might not persist in the face of perceived slow progress.

Gamification for MWC training

Gamification (applying gaming elements to skills training) and the development of video training games are strategies used to make rehabilitation more engaging and provide a graded progression of complexity and challenge. A number of gaming options have potential application for wheelchair skills training. Simple wheelchair-based activities and games have been used to increase the 'fun' factor while practicing skills, such as those suggested in the Wheelchair Skills Training Program.[4] An emerging area of innovation, sometimes referred to as "Virtual Reality" technologies, attempts to simulate or replicate diverse activities within a restricted environment. For example, adaptation of commercial products, such as the Nintendo Wii™ and Microsoft Kinect™, use input from an external device (controller) mounted to the wheelchair or recognition of specific wheelchair and body movements. However, these systems are limited in their effective use with a wheelchair due to issues such as the sensor's view of body segments being occluded in a seated position, the demands for limb and body movement as input, reflective nature of the wheelchair device which compromises sensor tracking, and the need to stay within the relatively small viewable zone of the sensor.[5] Several types of game-related interventions have been developed in recent years, and include both custom/dedicated systems and modifications to commercial or off-the-shelf products. The following section provides an overview of these applications.

Customized PC Approach

GAME^WHEELS is an innovation developed at the University of Pittsburgh, engineered as a stand-alone roller platform that incorporates a custom video game to train MWC propulsion.[6] Once the MWC is mounted in the structure, propelling the drive wheels emulates joystick movement, with faster speed indicating forward movement and turning (by adjusting the relative speed of each drive wheel) indicating left and right movement. Customized games and training information are displayed on a PC monitor mounted in front of the user. While the system has shown promise for improving propulsion technique and achieving a beneficial exercise effect, it requires a fairly elaborate structure to suspend the drive wheels and it does not currently address a wider variety of mobility skills beyond forward propulsion. This product is not yet commercially available.

Gaming Console Applications

Gerling et al.[5] have developed a custom software library for the Microsoft Kinect™ sensor, called KINECT^WHEELS, that allows several wheelchair movements to function as input signals for motion-based games. While the complexity of input is not as elaborate as that supported by the many commercial Kinect™ games (which track individual limb segment movement), it does enable the system to recognize discrete wheelchair movements to influence game play. The system recognizes four MWC movements: forward, backward and turning left and right. While the recognition rate and time were comparable to limb-based gestures (which can also be used for input), the system does not discriminate the distance, speed or angular movement of the wheelchair and consequently they operate like four directions on a joystick or arrow keys on a keyboard. As a result, the wheelchair can be used effectively as a method of interacting with and operating a motion-based game (i.e. improving accessibility to Kinect™ games for MWC users) but the software does not require or allow the precision of wheelchair movement required for training specific mobility skills.

Astrowheelie was another attempt to modify a commercial gaming system for MWC applications.[6] This innovation utilized the Nintendo Wii™ system, with two Wii controllers mounted to the spokes of a MWC using dedicated holders. The MWC user could then play the traditional video game Asteroids by wheeling forwards and turning left and right to reproduce the original joystick/keyboard functions. The system incorporates a laptop computer mounted on the user's lap. Similar to GAME^WHEELS, the primary intent is to provide an exercise effect rather than to practice or train specific mobility skills, although the latter could potentially be a benefit realized.

Customized video games

More recently, a computer tablet-based training program (EPIC Wheels) was developed for older adults incorporating video-based games that require performance of specific wheelchair mobility skills but without true interactive features or data transfer.[8] In addition to instructional videos, the program integrates training activities and games to induce practice and motor-learning of these skills. At present, the games are enacted while viewing video animation on the tablet screen, with the MWC user responding to game prompts by performing specific skills or manoeuvres. Preliminary analysis from an on-going RCT study suggests these video-based games are a popular program element among trainees. These games offer several potential advantages. They are relatively easy to create and configure for a simple video delivery format. The increasing challenge, as each game becomes progressively more difficult, can be a motivator for persistent practice. The novelty of animation may peek interest among users. The tablet-based gaming format allows trainees to play games without the need for a playing partner. One limitation is the lack of interaction between player and game. While the user moves their MWC in response to the video stimulus, their performance does not directly impact game action. For example, the Elevator game requires the user to enter and exit a virtual elevator on the tablet screen before the elevator doors close; however, the game continues regardless of whether the user is successful or not. With no data transfer, there is no feedback on, or tracking of, performance. The capacity to adjust the level of difficulty and provide performance feedback has been identified as important to game-related rehabilitation [9] and is a goal for further development of this intervention.

In response to the current game limitations, we are currently exploring the use of low-cost external sensors mounted on the MWC drive wheels to create a more interactive gaming experience called WheelTime. The Bluetooth-enabled sensors measure the relative orientation of the wheels and wheel travel, allowing us to track MWC movement and position. This provides several advantages over the gaming console devices. The sensors can track any movement in the x-y plane (forward, backward, turns, spins, etc.) and determine angular changes (i.e. partial versus full turns). The player does not need to remain within a small viewing range, as with the Nintendo Kinect™. The "occupied space" for the games can be customized within the software to ensure that the MWC user does not inadvertently run into obstacles in the room. For example, if the room has 3 by 4 metres of open floor space, these values can be easily inputted and the software adjusts the game-required wheelchair movement to occur within this footprint. The current WheelTime prototype also has some limitations. It requires customized gaming software that intentionally integrates wheelchair mobility skills, and continued development is time- and labour-intensive. Over time, the system requires recalibration to accurately locate the wheelchair position, and the relative position of the wheelchair in the x-y plane can be confabulated as the drive wheels change position relative to each other.

Two types of games are currently being considered: immersive and task-based. The immersive game provides relative freedom of movement and allows the user to pursue a goal and receive feedback on their achievements. For example, Plane Jane requires the user to catch drifting food items by propelling their wheelchair forwards and backwards and then turn and toss them to pilot Jane as she flies by. The task-based game is more prescriptive, requiring the player to perform a specific manoeuvre and providing feedback on their performance. For example, the Trivia game poses a question with three potential answers. The user selects their response by performing the associated specific task (e.g. make a 90° turn for answer "A"). The wheelchair movement is displayed in real time along a prescribed path on the tablet screen, and must be performed with sufficient precision before their "answer" is accepted. The games currently have several "skill settings", which allow for some grading of user performance demands; further refinement and development of increasing game levels (i.e. more challenging tasks, increasing complexity and greater performance precision demands) would improve the training effect. We are currently conducting testing of the sensor-based video games with groups of older adults to explore acceptability and user perceptions of wheelchair-controlled gaming activities. This feedback will inform the next iteration of sensor-based games and help set direction for further study.

Conclusions

Gaming technology holds considerable promise as a method of delivering wheelchair skills training. A variety of approaches are available, ranging from simple (non-technology) games to gaming console and custom computer gaming interfaces, each with benefits and limitations. Interactive gaming can encourage engagement in practice and enhance the extent of training completed. However, practice that is graded and requires greater precision in performance is more likely to provide therapeutic value of skills training. Current work is being undertaken exploring the use of external sensors located on the wheelchair drive wheels as a mechanism to create an immersive gaming experience. Evaluation of prototype games is underway with older adults to explore perceptions of the gaming experience and to inform further development.

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3iii: Feasibility of a Peer-Led, Self-Efficacy-Enhanced Wheelchair Training Program for Older Adults: Study protocol of a randomized controlled trial

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Introduction

Manual wheelchairs (MWC) are prescribed to nearly 100,000 older Canadians who experience difficulty walking.[1] However, procurement alone does not guarantee safe independent use or satisfactory performance in meaningful activities. Despite potential benefits, unsuccessful MWC use is associated with risk of accidents and injuries,[2,3] mobility dependence,[4] and restricted performance in major life activities.[5]

Training is a critical component of successful wheelchair procurement.[6] Although there is empirical support for safe and effective Wheelchair Skills Training Program (WSTP) for community-living MWC users that is facilitated by health professionals,[7-9] relatively few MWC users receive training.[10] Basic wheelchair skills training (e.g., maneuvering in small spaces) is provided in 66% of Canadian rehabilitation centres. However, due to lack of time and resources, less than 10% provide training in advanced skills that are critical for community mobility and participation (e.g., descending curb cuts).[11] Moreover, it is likely that the large number of older adults who independently purchase wheelchairs directly from community vendors receive even less training. Alternative approaches to MWC training may increase opportunities for older adults while alleviating clinician burden.

Wheelchair use self-efficacy (i.e., one's belief in ability to overcome challenging situations when using a MWC) is important for MWC mobility.[12-14] According to Social Cognitive Theory, self-efficacy can be remediated through peer observation, successful performances, verbal reinforcement, and understanding physiological responses.[15] Peer-led interventions effectively improve various health behaviours (e.g., physical activity).[16,17] Moreover, peers may be especially influential as they provide a sense of understanding and credibility.[18,19]

Preliminary evidence supports peer-led training for improving MWC use self-efficacy and skills in adults.[20] The primary objective of this study is to evaluate the feasibility (i.e., process, resources, management, and treatment) of a peer-led, Wheelchair Self-Efficacy Enhanced for Use (WheelSeeU) training program for older adults. The secondary objective is to provide effect size estimates for clinical outcomes, including: wheelchair skills capacity [primary], wheelchair skills performance, wheelchair use self-efficacy, life-space mobility, satisfaction with performance, activity and participation, health-related quality of life and health utility.

Method

Design: A randomized controlled trial is conducted at 2 sites (Vancouver, BC and Québec, QC).

Participants: 40 MWC users are recruited on a volunteer basis. Inclusion criteria: ≥50 years of age; live in the community; self-propel a MWC (~1 hour/day; have wheelchair mobility goals; and be cognitively able to engage in the program. Exclusion criteria: unable to complete study questionnaires in English or French; anticipate health conditions/procedures that contraindicate training; have degenerative conditions that are expected to progress quickly; or are receiving or planning to receive wheelchair mobility training during the study period.

Procedure: Participants are randomly assigned to either the treatment group (WheelSeeU) or the control group (iWheel). Participants in both groups attend six, 1.5 hour training sessions at a frequency of one to two sessions per week.

Treatment group (WheelSeeU) - is co-administered by a peer-Trainer (MWC user for at least 10 years) and a support-Trainer (health professionals with at least five years of experience working with MWC users). The peer-Trainer facilitates individualized goal setting, sets manageable task objectives for each session, and provides wheelchair training. The peer-Trainer also presents situational vignettes using descriptions and personal experiences. The support-Trainer provides assistance with goal setting and identifying task objectives when required, and reinforces safety during practice.

Control group (iWheel) - Resources for improving Wheelchair use (iWheel) is administered by a health professional with at least five years of clinical experience. iWheel sessions are based on general wheelchair use topics (e.g., accessing the city, MWC maintenance, physical activity and nutrition). A didactic Power Point lecture guides an interactive discussion based on points of interest.

Data collection: Sociodemographic and personal information (e.g., age, sex, marital status, education, primary diagnosis related to MWC use, length of time using the MWC, and propulsion method) are collected at baseline.

Feasibility indicators for process (e.g., recruitment, retention), resources (e.g., adherence, burden), management (e.g., participant processing), and treatment (e.g., treatment effect) are measured during administration and at study's end.

Clinical outcome measures are collected at baseline (pre-randomization), post-intervention, and six months post-intervention in French or English. Wheelchair skills capacity (primary clinical outcome), is measured using the Wheelchair Skills Test version 4.1 (WST).[21] Secondary clinical outcomes include: perceived wheelchair skills capacity and performance (WST-Questionnaire)[22], MWC use self-efficacy (Wheelchair Use Confidence Scale)[12] life-space mobility (Life-space Assessment)[23], satisfaction with performance (Wheelchair Outcome Measure),[24] activity and participation (Late-Life Functioning and Disability Index),[25], health-related quality of life and health utility (Health Utility Index Mark III).[26]

Analyses: Summary statistics are calculated (mean/standard deviation for continuous variables, and frequency/proportion for categorical variables). Feasibility indicators are treated as binary ('successful/unsuccessful'). 'Success' indicates the protocol is sufficiently robust to move forward with a large RCT with small/no adaptation required, while 'unsuccessful' indicates a need for changes to the protocol before proceeding. Analysis of covariance (ANCOVA) is used to determine post-intervention between-group differences for all clinical outcomes. Effect sizes are estimated calculated as the ratio of the effect and total sums of squares (partial η^2). Significance is alpha = 0.10 and 90% confidence intervals are estimated.

Clinical Implications. WheelSeeU is an innovative approach for providing wheelchair skills training to an aging population. The benefits of an effective peer-led intervention include limited direct contact with a clinician and development of community-based social supports. WheelSeeU has the potential to influence wheelchair mobility, health, and social participation in older adults. Results from WheelSeeU could change the way older adults use their wheelchairs, having great potential for use across age and diagnostic groups, going beyond simply technical skills and targeting other crucial cognitive areas, such as self-efficacy.

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3iv: Long-Term Care Facility Residents' Initial Experiences and Perceptions of Intelligent Power Wheelchairs

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Introduction

Many older people who live in long-term care (LTC) use a manual wheelchair as their primary means of mobility. Unfortunately, many of these individuals are unable to self-propel these devices and, therefore, must rely on others for assistance with mobility. Power wheelchairs are a potential means of mobility for residents who are unable to propel manual wheelchairs; however, many residents lack the motor and cognitive skills necessary to enable their safe operation[1]. To facilitate increased use of power mobility, there has been ongoing work in the development of intelligent power wheelchairs (IPWs).

An IPW uses different types of sensors (e.g., sonar, laser, vision-based) to prevent the driver from making contact with things within the environment, or to allow the wheelchair to autonomously transport the user between locations. Our research team has developed several prototype IPW systems that are designed for residents with cognitive impairment living in LTC. The prototype used in this study offered three intelligent modes, with different levels/types of support: (1) speed correction (i.e., the wheelchair slows down and/or stops to avoid obstacles); (2) heading and speed correction (i.e., the wheelchair steers away from obstacles and provides audio direction prompts), and (3) automatic driving (i.e., the wheelchair completes specific driving tasks without user input while avoiding obstacles). These modes were simulated by Wizard of Oz technology, where a hidden researcher remotely modified the speed and/or direction of the wheelchair based on obstacles encountered (rather than sensor data and decision-making algorithms) thus simulating an IPW [2,3,4].

To develop an understanding of the potential impact of an IPW on residents in LTC settings, the purpose of this study was to explore a) how residents experienced an IPW that used three different modes of control and b) what perceived effect the IPW would have on their daily lives.

Methods

Design
Semi-structured interviews were used to collect the data. The study was approved by the local university ethics board and the test facilities.

Sample and Recruitment Procedure
Volunteer sampling was used to recruit 10 powered wheelchair users from three LTC facilities in the Lower Mainland of British Columbia. Participants were recruited with the assistance of third-party collaborators at the LTC facilities if they: were ≥ 50 years old, had a mild to moderate cognitive impairment, were able to sit in a power wheelchair for two hours/day, were able to operate a joystick, could hear audio prompts from the IPW and could communicate in English.

Data Collection and Analyses
Participants were interviewed pre- and post- trial of the IPW. The pre-trial interview was designed to explore the participants' mobility experiences and activities within and outside of the LTC facility and initial perceptions regarding the IPW. The post-trial interview was designed to explore the participants' experiences with driving the IPW in the three modes (described above) and their perceptions regarding the potential impact of the IPW on their lives and the lives of those around them. Illustrative videos of the three driving modes were used to facilitate discussion for the pre-driving interviews. For the post-driving interviews, illustrative videos of the participants themselves driving the IPW in the three modes were used to compensate for memory deficits and facilitate discussion. Interview questions were open-ended and had a variety of probes. Socio-demographic data were also collected via a questionnaire. The qualitative data were analyzed using a thematic analysis approach, as outlined by Braun and Clarke[5], and sociodemographic data using summary statistics.

Results

Six of the ten participants were women and ranged in age from 62 to 98 years old. Seventy percent of the sample used a manual wheelchair as their primary mobility device, while 30% used a power wheelchair. The sample had a wide range of wheelchair experience (range: 2 to 14 years).

Our final thematic analyses identified three overarching themes. The first theme, *the difference an IPW would make*, suggested that use of an IPW with in LTC would lead to increased participation (e.g., facility-based activities, visiting friends in the facility), increased safety (e.g., decreased collisions with static and dynamic objects) and enhanced feelings of well-being (e.g., happiness, confidence). The second theme, *the potential impact of the IPW on others*, highlighted how an IPW would decrease required assistance, worry and frustrations. The third theme, *IPW related concerns*, described technological (e.g., the challenge of collision avoidance in busy areas) and personal (e.g., giving up control) concerns.

Discussion

This study is the first to explore the perceptions of LTC residents before and after trialing an IPW. The residents' opinions of the positive benefits regarding the use of an IPW in LTC are promising. Also valuable was the feedback regarding concerns, as it provides us with the opportunity to continue to improve the IPW design. Future studies will involve testing changes to our IPW prototype based on findings from this study with the ultimate goal of enhancing mobility and quality of life for residents with cognitive challenges living in LTC.

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3v: Smart Wheelchairs in Assessment and Training (SWAT): Findings from a Consensus Workshop

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Introduction

Mobility has been identified as an essential component of well-being and quality of life[1]. Powered wheelchairs (PWCs) can offer independent mobility to individuals who are unable to walk or to self-propel in manual wheelchairs. Decisions related to provision of these devices are made by clinicians during assessment and training sessions. PWC eligibility is typically determined based on clinical experience and reasoning, while accounting for client needs, goals, and abilities on an individual basis[2]. Standardized assessment and training tools can help inform and/or augment, rather than replace, current clinical practice; however, a small number of standardized tools that exhibit both scientific rigour and clinical utility is currently available. Furthermore, identifying gaps in existing assessment and training tools can lead to the creation of new tools and processes that help improve current practice while ensuring that no individual is unduly excluded from the benefits of PWCs.

Researchers have attempted to build “smart” wheelchair technologies for decades[3]. These technologies consist of different types of sensors that can collect data on the PWC, the PWC user, the environment, as well as the interactions amongst them. The above information is then used by the smart wheelchair to modify behavior of the PWC and/or user. It is possible that these technologies could be used to develop tools that can optimize the time spent in training, and aid in the assessment of specific aspects of PWC driving, such as safety. However, the use of these technologies by clinicians and their clients in assessment and training is largely unexplored, and was thus the main focus of a workshop on Smart Wheelchairs in Assessment and Training (SWAT) held in October 2014 in Toronto, Canada.

Purpose

The main objectives of the workshop were to:

1. Exchange knowledge of current practices in assessment and training, and identify additional information to assist in clinical decision-making;

2. Exchange knowledge of the sensor data and intelligent processing currently offered by smart wheelchairs;

3. Brainstorm applications of smart wheelchairs in informing and/or augmenting assessment and training processes, and the implications of using this technology from a clinical perspective,

4. Identify future research directions in applying state-of-the-art smart wheelchair technology to assessment and training;

Methods

In order to understand the gaps in current clinical practice and existing tools, the Cornell Institute for Translational Research on Aging (CITRA) consensus model[4] was employed. First, a literature review of standardized powered wheelchair assessment and training tools, clinical guidelines and best practices, as well as emerging tools was conducted. In addition, examples of sensors commonly used in smart wheelchairs were documented. A non-technical report summarizing the above information was circulated to 38 “experts” around the world with experience with PWC interventions - engineers, computer scientists, clinical researchers, clinicians, a PWC vendor, a wheelchair controller manufacturer and a policy maker. Thirty-one of these experts attended a 1.5 day workshop in Toronto, Canada. The workshop included small group brainstorming and large group discussions, as well as a Question and Answer panel.

A summary of all workshop notes was created and circulated to all the workshop attendees as a form of member checking, along with a brief survey asking participants to identify key insights on current practice, challenges to be addressed, and recommendations. All information collected above was then analyzed by an interdisciplinary group of five researchers.

Results

Key findings from the discussions, and comments/feedback collected post-workshop through the survey and emails were clustered in three areas: challenges in assessment and training current practice, potential technology solutions, and challenges in development and deployment. Challenges in current practice included a) current limitations in the roles and goals of powered mobility, b) variability in clinicians, clients, and processes, as well as c) barriers and restrictions to powered mobility access. Workshop participants agreed that smart wheelchairs and their data have the potential to assist in PWC assessment and training. Potential technology solutions were suggested that can aid in assessment and monitoring, and/or provide assisted mobility. Several clinical, technical, financial, ethical, safety, and commercialization issues were identified as presenting significant challenges in the deployment of smart wheelchair technologies. Conflicting needs and objectives of the different stakeholders emerged during the workshop, with communication and professional language barriers posing as a major source of tension. Nonetheless, collaboration between clinicians, researchers, and entrepreneurs / inventors was identified as being valuable. The importance of including end-users in future discussions was also noted.

Recommendations
Workshop findings highlight that the successful deployment of smart wheelchair (and other assistive) technologies requires buy-in from various stakeholders, including end-users, therapists, researchers, developers, and policy makers. Strong collaborations, knowledge translation, and knowledge mobilization are thus essential in ensuring buy-in and adoption. We recommend that existing and new research and development ideas be evaluated on an ongoing basis, through open and honest discussion with all stakeholders, in order to identify shared interests, motivations, responsibilities, and the potential for collaboration among smaller groups. Finally, balancing low-hanging fruit with some of the longer-term research questions posed in academic settings can help move assistive technologies forward while solving some of the current challenges faced by clinicians and their clients.

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C1: Em-POWERment: Power Mobility Training Methods for Children and Adolescents with Multiple Severe Disabilities

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Introduction

Children and adolescents who have severe motor, cognitive, and communication deficits are often limited in their ability to use self-generated movement to explore and learn from the world around them. Such children are frequently dismissed as "too involved" or "too low functioning" to use power mobility. Specific research suggests that power mobility may help children who have severe motor disabilities to develop cognitive[1,2] and psychosocial/play skills[3] while increasing initiation,[4] self-exploration,[5] and independence.[1] Recent work by Livingstone and Paleg[6] suggests that power mobility may be beneficial for children with multiple, severe disabilities even though these children may never become capable, community drivers.

Durkin[7] suggests that rather than teaching power mobility skills, clinicians should create a responsive partnership with a child to promote functional use of a power mobility device. Within this partnership, environmental exploration and play are used to encourage and promote power mobility skills within a context that is meaningful for the individual child.[7] Nilsson & Nyberg[5] and Nilsson et al.[8] further suggest that the experience of using power mobility may improve alertness in children with severe disabilities and may eventually stimulate the development of intentional, purposeful driving behaviors.

Using these concepts as a framework, power mobility training methods were developed for use with children and adolescents ages 9 months to 26 years who have multiple, severe disabilities. These power mobility training methods are designed to actively engage children in individually motivating activities within an environment specifically structured to elicit basic power mobility skills. The following steps are used to provide a standardized, systematic means by which to individualize the training environment and meet the needs of each child: (1) Identify specific motivational and reinforcement factors for each individual child are identified through administration of the standardized parent interview outlined in the Reinforcement Assessment for Individuals with Severe Disabilities (RAISD),[9] (2) Generate child-specific goals related to the development of basic power mobility skills using the Power Mobility Training Tool (PMTT),[10] (3) Based on the information gathered in Steps 1 and 2, create an engaging environment was designed to target the emergence of the specific power mobility skills, (4) Respond to the learning and safety needs of each child using a custom-made attendant control unit to selectively modify the direction and motion of the power mobility device, and (5) Provide individualized verbal and physical prompts to promote and encourage the child's active participation in the training.

Overview of Each Step in the Training Methods

To determine a child's individual preferences, the RAISD[9] is used as a structured interview to gather information from each child's parent or caregiver related to potentially reinforcing stimuli (visual, auditory, tactile, kinesthetic, etc.) and activities for the specific child. The RAISD[9] includes 10 open-ended questions such as "What are the things you think (your child) most likes to watch" and "What activities (physical play and movement) you think (your child) most enjoys?" After each open ended question, additional probing questions are asked to gather more specific information on the child's specific preference in each area.

The PMTT[10] is then used to identify the existence of basic power mobility skills for each child. The PMTT[10] is not an outcome measure but rather was developed as an observational assessment tool to help guide the design of therapeutic interventions that promote the development of basic power mobility skills in children with multiple, severe impairments. The PMTT[10] can be used with children who access a power mobility device with either a joystick or a switch(es). The PMTT[10] consists of 12 items related to basic power mobility skills that are scored on a 5-point ordinal scale from 0 = Does not attempt the skill or the skill is not demonstrated or observed to 4 = Demonstrates the skill >90% of the time without manual assistance/prompts. Sample items include "Appears to recognize the correlation between the access method (switch or joystick) and movement of the power mobility device" and "Demonstrates the motor ability to sustain activation of the access method (switch or joystick) to move the power mobility device for >5 seconds". Two additional items related to the child's positioning in the device and apparent motivation to drive are scored on a yes/no basis. Findings from the PMTT[10] are used to create goals in the area of basic power mobility skills for each participant.

Individual preferences for each child as identified by the RAISD[9] are then used to create an engaging environment that is customized to target the emergence of power mobility skills as outlined by the individual goals and desired parental outcomes for each child. For example, a child might appear to enjoy knocking over Styrofoam® bolsters. To support his parents' desired outcomes to develop cause and effect skills and to work on the ability to activate a switch to move the power mobility device as identified by the PMTT,[10] these bolsters might be initially placed so that any incidental movement of the power mobility device would knock over the bolsters. As his abilities progress, the bolsters could be positioned so that he had to intentionally move the power mobility device to knock over the bolsters. By combining findings from the RAISD[9] and the PMTT,[10] children are able to practice basic power mobility skills and self-exploration while purposefully engaged in activities that are meaningful to them.

Safety is frequently a concern during power mobility training. Often the greatest concern is that a child will be injured while driving or that the child might injure someone else during a collision. However, just as typically developing children learn by moving under and over objects and by bumping their head as they try to stand up underneath a table, children learning to use power mobility must be allowed to learn from their environment and from their errors.[7] To address this issue, shared control of the power mobility device is used to provide a safe means to promote learning and to avoid unsafe encounters. Shared control is defined as the electronic capability to modify the direction and motion of the power mobility device by combining inputs from both the user and attendant control units without having to stop or interrupt the child's driving.[11] Using shared control, the therapist is able to make adjustments to the path of the power mobility device while the child continues driving. These adjustments are used to steer the device away from environmental hazards but also to selectively prevent the child from becoming frustrated or confused about maneuvering the device. For example, children using a single forward switch are not able to turn in any direction. Shared control allows the therapist to maneuver the device while the child maintains forward switch activation. Shared control also can be used to slow down the power mobility device while it was in motion thereby allowing a child to gently collide with walls or other safe obstacles and promote learning. Whereas stopping the movement of the power mobility device and switching back and forth between the user and attendant control units may be confusing (especially for children who may not yet understand cause and effect skills), shared control allows children to move within the environment with the added safety of the therapist acting as a responsive partner in the learning process.

Although children given the opportunity to activate the switch(es) without assistance, verbal prompts or physical prompts are used as necessary to engage the participants or to call attention to the switch(es) during training. Prompts are individualized for each child and are consistent with his/her preferred methods of communication and interaction. Hand-over-hand assist is used as needed to demonstrate the action of the switch(es). All prompts and assist are weaned as soon as possible to promote motor learning and decrease the chance that children might become dependent on the use of prompts.[12]

Based on preferences for praise as gathered on the RAISD, children are praised for their efforts during intervention sessions. Process praise that focuses on behavior and effort rather than on personal attributes has been found to be beneficial when working with children who have special needs.[13] This type of praise was incorporated into sessions by stating, for example, “Nice turn” or “You found your sister”. Negative feedback implying that the child has done something wrong is avoided. For example, if a child bumps into the wall or other object, it is simply stated that the child “found” the wall rather than saying “Don’t run into the wall!”.

Conclusion

Providing an individualized power mobility training environment that is motivating to a child is consistent with concepts related to the salience of rehabilitation interventions.[14] Setting up the environment so that children repeatedly practice targeted power mobility skills (such as turning or stopping) reflects concepts of practice, specificity of training, and repetition.[12,14] The use of shared control to maintain safety and yet allow for errors is consistent with the need to involve children in problem-solving processes that allow them to learn from their mistakes.[7,12,14] Although additional research is needed to assess the effectiveness of these training methods, preliminary data indicates that these training methods may assist children and adolescents who have multiple, severe disabilities to develop basic power mobility skills.[15,16]

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C2: ISO Performance Standards for Postural Support Devices

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I, Kelly Waugh, received consulting fees from Bodypoint, Inc. for the development and delivery of this presentation.

A Postural Support Device (PSD) is any component of a body support system in a wheelchair that has a surface intended to contact the wheelchair occupant's body[1]. The International Organization of Standards (ISO) develops wheelchair standards that help manufacturers design better products and provide data that can make your job as a service provider more efficient and valuable.
There are two newly revised ISO seating standards related to PSDs that provide us with critical information – about the person's body, and about product options – that helps us make better decisions regarding seating strategies and product recommendations. Using the knowledge from these standards, we can achieve better outcomes for our clients, provide improved value for payers, and elevate the level of professionalism in our field.

Product Performance
Product performance speaks to how well a product does what it was intended to do. Three things determine a product's performance: DESIGN, QUALITY, and APPLICATION. A product's DESIGN is characterized by its features, for example materials, shape and dimensions. A product's QUALITY is effected by its design and construction, the goal being durability and safety. Product APPLICATION speaks to how a product is used or applied, and this is critical to product performance. There are three requirements for optimal product application. First, the product features must address the specific health and functional needs of the individual who will be using the product. Second, the product is appropriately sized to match the person's body dimensions; and third, the product is set up or configured appropriately, including proper mounting, linear placement, and angular adjustment. A product of exceptional design and quality may not perform well if it is not sized, adjusted and applied correctly.

There are two specific ISO standards related to PSDs that help provide critical information about the wheelchair user and about PSD products, to help insure product performance. ***ISO 16840-1: Wheelchair Seating, Part 1- Vocabulary, reference axis convention and measures for body segments, posture and postural support surfaces***[2] identifies and defines important data about the person, which helps in the proper application of PSDs. ***ISO 16840-3: Wheelchair Seating, Part 3-Determination of static, impact and repetitive load strengths for postural support devices***[3] gives you important data about the product, specifically about the design and quality of PSDs that have been tested to this standard.

General characteristics of standards
Industry standards are typically developed to ensure the safety and quality of products. They usually contain either specific performance tests, or they define terminology – or both. The standards that contain specific performance tests – called **performance standards** - specify test methods that measure either product performance or product characteristics. All performance standards with test methodologies have disclosure requirements that specify what test results must be disclosed to the public[5].

There are three basic types of performance tests. **Pass/Fail** tests define minimum performance criteria. For example, static and impact strength tests for wheelchair frame components are pass/fail tests. The test will specify a load to apply to the component, and must disclose if the product fails or passes. These types of tests insure minimum performance and safety. The second type of test are those that produce **quantifiable information**, called a “performance value”. In these tests, there is no minimum performance criteria. The wheelchair static stability test is an example of this type of test[5]. There is no minimum or maximum performance criteria, only a performance value. This allows comparison of products and models, as the clinical application depends on the needs of the consumer. The third type of performance test is called **destructive testing** or “load to failure”. In these tests, increasing loads are applied to a product or component until it fails, and the point of failure is measured and recorded.

It is important to understand that while standards allow comparison of products with respect to a specific feature or performance criteria, they will not tell you “this will work for my client”. Standards also do not dictate a standard evaluation process or prescription outcome. Standards are regularly reviewed and revised, and are **voluntary**. So why would manufacturers choose to test their products to a specific standard when this testing costs money? When consumers start using standards to compare and choose products, this creates marketing pressure often resulting in universal adoption of the standard by all manufacturers.

ISO 16840-1: Wheelchair Seating, Part 1- Vocabulary, reference axis convention and measures for body segments, posture and postural support surfaces

This standard, first published in 2006, defines terminology. More specifically, it defines standardized terms for linear and angular measurements of the seated person’s body, and for the wheelchair’s seating support surfaces. It thus provides a standardized way to gather and communicate information about the characteristics of the ***person*** and the ***seating system***, in a manner which allows more accurate and efficient translation of body measures into a seating prescription. Accurate measurement of the wheelchair occupant’s body and their seated posture is critical to ensuring the appropriate fit and application of PSDs with respect to feature matching, sizing and adjustment. A clinical application guide to this standard was published in 2013[6], and currently contains the most updated information from this standard, upon which revisions to the ISO standard are currently being made.

ISO 16840-3: Wheelchair Seating, Part 3-Determination of static, impact and repetitive load strengths for postural support devices

This is a performance standard that specifies test methods that provide information on the ability of a PSD to withstand static, impact and repeated loads. It establishes performance criteria for some tests; in other tests no minimum requirements are currently specified. There are three types of tests in this standard: static tests, impact tests, and repetitive load tests. In a **static strength test**, a specified load is applied to the PSD one time for a certain number of seconds, where the load is based on the size of the intended user. In an **impact strength test**, a higher load is applied with a pendulum one time; and in a **repetitive load test**, a smaller load is applied repetitively, for 1000 cycles.

This PSD performance standard specifies test methods for nine different types of PSDs, including non-rigid type supports such as anterior pelvic supports, and rigid PSDs such as the seat, head support, or lateral trunk supports. The tests are designed to mimic the forces that will be applied in real life scenarios; therefore, not all types of tests are performed for each type of PSD. All of the tests in this standard are designed to reflect a 'worst case situation' that is repeatable and doesn't require destroying numerous wheelchairs in the process of testing.

Anterior pelvic supports and anterior trunk supports tend to be flexible supports, like pelvic positioning belts and anterior shoulder straps or harnesses. The tests for anterior pelvic and trunk supports are pass/fail tests that tell you whether or not a product meets defined minimum performance criteria when subjected to loads during intended use. In these tests, the product being tested is mounted onto a **rigid test fixture**, which simulates the wheelchair frame. The PSD being tested is applied to a block called a **loading pad** that simulates the wheelchair occupant's body and transfers the load to the PSD. Loading pads are based on anthropometric data for different body sizes, so the manufacturer chooses the appropriately sized pelvic or torso loading pad to match the range of application for the size of the PSD to be tested. (This shows how testing products to this standard helps manufacturers give information to the consumer on proper sizing and intended use for their products.) The **loading device** is the structure which applies the load through the loading pad, to the PSD being tested.

During the repetitive load test for a pelvic belt, in order to pass and be ISO compliant, the belt cannot move or slip more than 10mm. This is an example of a 'minimum performance criteria'. Examples of failure in the tests for anterior pelvic and trunk supports include cracks, tears, broken stitches, buckles breaking, slippage in position or adjustment of the PSD more than 10mm, or an inability to achieve maximum load under specified test conditions. These types of failures can be the result of less than optimal product quality or design, attachment points that are too wide or inappropriate sizing of the product to the loading pad. Experiencing these types of failures during testing would prompt the manufacturer to make design improvements to address these failures. This is how standards help drive improvements in product performance!

The tests for seats, back supports, lateral/medial supports and arm/foot supports are destructive or "load to failure" tests. They tell you how much force the PSD can withstand before it fails, such as how much force a lateral trunk support can withstand before bending or breaking. The test process for these destructive tests is similar to those for anterior pelvic/trunk supports, except that there are no minimum performance requirements. This is because we don't currently know what type of loads are experienced by these supports during normal intended use, so a test load cannot be specified. In these tests, the load is gradually increased until the product fails. The tester then records the type of failure(s) which occurred, and the load and/or number of repetitions that resulted in failure. The results of these tests are more difficult to apply clinically, as we don't yet know the typical forces applied to these supports. For example, it may be irrelevant that product A failed at a lower load than product B, because that lower load may still be way above what the PSD would ever be subjected to in real life.

In summary, wheelchair seating standards benefit our industry in many ways. Terminology and measurement standards improve the accuracy of product prescription and product application, as well as service delivery efficiency. Performance standards help manufacturers design better products, because testing informs design. Testing to standards helps manufacturers evaluate their products' ability to meet the requirements of the marketplace—it helps them to design smarter to meet the expectations of customers, without overbuilding. Manufacturers who test their products to these voluntary standards can also provide clients, therapists, and suppliers with intended use descriptions of their products - because they've learned how their products perform best. As standards become adopted by customers or are required by payers, meeting those standards are an absolute requirement for success.

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C3: The Art of Balance: Function and Posture in Wheelchair Seating

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Background

Balancing function and managing postural deformity is a primary challenge and constant dilemma for clinicians working in the field of seating and mobility prescription. Function and posture inherently influence one another throughout the seating process. So much so that these two concepts often conflict with one another. Function is defined as: “the purpose for which something is designed or exists”[1]. Using this definition, function, itself, can be seen as the purpose for one’s existence. This profound concept illustrates the importance of identifying a client’s functional goals. The definition of posture, on the other hand, is “the way in which the body is positioned when sitting or standing”[1]. The consideration of the client’s posture is the foundation of the physical seating assessment[2]. Anatomical and biomechanical principles are, for example, primary considerations during the mat and sitting assessments. Integrating these two concepts is by no means an easy process. It involves astute assessment and clinical reasoning skills. The implications of not balancing functional and postural considerations throughout the therapeutic process are significant and they can have a profound impact on the user’s satisfaction with their mobility system, health and quality of life. Some specific implications are as follows:

Possible implications of considering or over-prioritizing function:

- Increased postural deformity
- Skin integrity and risk for breakdown
- Health implications due to worsening postural deformity: worsening or developing dysphagia, poor digestive health, compromised respiratory health, poor circulation
- Pain
- Poor self esteem due to deteriorating posture and physical appearance[3]

Possible implications of considering or over-prioritizing posture:

- Potential negative impact on functional ability
- Restricting movement, resulting in muscle weakness
- Dissatisfaction with medical equipment
- Equipment abandonment[3]
- Pain
- Decreased quality of life

Function-Posture Balance Model (FPB Model): Figure 1

The Function-Posture Balance Model is a model designed to reinforce the need to constantly consider posture and function throughout the entire seating process. Although the outcome of a seating system may often involve sacrificing either some functional goals in order to achieve improved postural goals or vice versa, the consideration of both must be equal and constant throughout the therapeutic process. This process must be collaborative as some of the aspirations of the client and the clinician may conflict[3], just as some of the client's own aspirations and goals can conflict with one another. A client for example, may want to sit straighter, but may also want to optimize their ability to reach things in their cabinets. Or a client who experiences pain may prefer a firmer sitting surface for more stability for self-propelling, but requires more pressure distribution for pressure relief and comfort. A client centered approach is at the forefront of this model as it encourages clinicians to constantly weigh and negotiate the goals of the system in order to create a seating and mobility system that will best benefit the client and address all of their current and foreseen needs.

Fig 1: Function Posture Balance Model (FPB Model)

How to use the model:

The goal of the model is to ensure that the function side and posture side of the balance is always level and balanced in terms of their equal consideration. The consideration of functional and postural issues must be done throughout the seating process as illustrated at the bottom of the model. This is to ensure that one side does not outweigh the other or is accidentally forgotten as the client and therapist move through the seating process.

Examples of use of the model

Observation/Interview: During this stage clinicians are gathering information from their clients either through interview or observation. Clinicians are encouraged to ask for and observe for possible functional and postural issues that will influence equipment procurement. For example, a client may use their wheelchair back canes to hook onto to support themselves while reaching for objects. The clinician must then consider a seating system that allows that client to hook in order to function, but may also need to consider equipment that could provide more trunk support to prevent postural deformity in the future.

Physical Assessment: The focus here is on gaining postural information in order to determine what is possible posturally either through accommodation or correction. Physical assessment typically involves palpation and identification of the client's current posture in their seating system, a mat or supine assessment, range of motion assessment, and a sitting simulation. Function should also be assessed here, such as head control, sitting balance, transfers, technique of propelling or controlling wheelchair, and ability to reach or use arms or hands freely. Determining a client's optimal posture and positioning along with optimal level of function at this stage is crucial.

Trials/Simulation: Equipment trials or simulation are highly recommended to ensure balancing posture and function. When the client is able to trial the system for a period of time in the environment of use, issues can arise that were not identified earlier and this provides the opportunity for the client and clinician to problem solve solutions and prioritize posture and functional goals prior to making final decisions. At this stage often it becomes evident that modifications to the environment are required to ensure ongoing function due to changes in the seating system. For example, if more trunk support and tilt is required to achieve a more upright posture, adjustments to the client's workstation may be required which can all enable the client's functional goals while still maintaining a more upright posture within the seating system. This could include, raising the desk so that the client can clear their knees under the desk, bringing the computer access equipment closer to the client, and ensuring appropriate monitor height.

Report/Justification/Funding: This is where functional and postural goals are documented. Goals are negotiated with the client and is then documented for funding purposes but also for reference during the set-up or fabrication process.

Setup/Delivery/Fabrication: During set-up or fabrication, trial of different functional activities during the process ensures that the client's postural needs and functional needs are being met. Asking the client to check their sitting balance, to try driving or self-propelling in their wheelchair, reaching for items, or transferring can confirm that functional issues are considered. In addition, asking whether a client is experiencing pain, palpating for adequate contact or using modalities such as pressure maps can assist with addressing postural goals.

Follow-up/Education: This step is important to ensure ongoing success with the new equipment after a period of use, including any necessary training of client/caregivers , evaluating outcomes of goals, and finalizing any environmental modifications. Modifications to the environment may be required here if sacrifices are made in the seating system itself.

Summary

The FPB Model emphasizes and illustrates the dynamic relationship between functional and postural considerations during seating and mobility prescription. A seating and mobility system that prioritizes postural outcomes and does not allow a client to function to their optimal potential can gravely affect satisfaction, quality of life and well being. While a system that considers function alone can result in a decline in physical health, which can eventually affect functional performance. Clinicians are encouraged to approach the seating and mobility assessment with a client-centered lens by constantly considering, reconsidering and negotiating functional and postural goals with their clients in order to ensure a successful seating and mobility system prescription and set-up.

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C4: Aging with Cerebral Palsy

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Marlene Holder Physiotherapy

I, Marlene Holder, do not have an affiliation with an equipment, medical device or communications organization.

The management of children with cerebral palsy (CP) is well known with established teams and protocols. As life expectancy increases for individuals with CP[1], extending coordinated care across the lifespan is necessary. Unfortunately, the current services and clinical expertise following transition to adult health care are characterized as limited.[2,3] As such, clinicians must develop increased knowledge and expertise to meet the needs of this aging population.

An underlying knowledge of CP is required in order to look at the effects of aging. CP describes a group of disorders of the development of movement and posture including abnormalities of muscle tone, movement disorders, disturbances of sensation, perception, cognition, communication, and behaviour[4]. As individuals with CP present with a broad range of functional abilities, the Gross Motor Function Classification System (GMFCS) for cerebral palsy was developed to describe these motor abilities in a reliable way. The GMFCS consists of 5 levels with level I being most able and level V least able.[5] The purpose of this tool was to assist clinicians to predict functional mobility in children and has since shown stability into early adulthood.[6] Continuing to use this classification system for adults with CP creates a common language to describe severity of motor function and identify changes in ability over time. In the future, factors identified at each GMFCS level may guide expectations for functional changes for adults with CP.

Although CP is a non-progressive group of movement and postural disorders, secondary complications increasingly impact function into the adult years.[6,7] Adults frequently present with pain and declining function related to secondary conditions which include bony deformities, soft tissue contractures, degenerative arthritis, osteoporosis and chronic fatigue. Adults with CP experience age related changes earlier than their peers[2] although the interaction between the secondary complications and the aging process is only beginning to be understood.

Pain is the most consistent secondary condition reported by adults with CP.[8] It can often be attributed to the effects of hypertonia, musculoskeletal disorders and falls. Pain is often self-managed as few options are provided when medical care is sought.[8] Controlling pain through the management of hypertonia includes but is not limited to oral baclofen, intrathecal baclofen, Botulinum Toxin A (BoTN-A) and Artane.[9] Whenever the goal of tone reduction is considered, it is important to determine whether tone is being used in a functional manner, for example to facilitate weight shift in sitting or for standing transfers.[10] If tone is being activated for functional activities, reducing the tone may limit participation. Benefits of effective hypertonia management include increased comfort, improvements in activities of daily living and improved access to control wheelchairs and augmentative communication devices.

Musculoskeletal disorders that began during childhood continue to progress into adulthood when they can severely limit function. This can cause a cycle of decreased mobility with less frequent position changes leading to an even greater risk of contractures and progressive deformities.

Common disorders include patella alta, hip displacement, scoliosis, spondylolysis and cervical stenosis.

Ambulatory adults with CP, GMFCS level II or III, may present with worsening crouch gait and anterior knee pain related to patella alta. This condition may be further aggravated by accompanying stress fractures, tendonitis, bursitis and subluxation leading to decreased ambulation and increased use of wheeled mobility[11]. Beginning to use wheeled mobility may involve a change in mindset for some adults to move from viewing a wheelchair as a last resort to accepting the benefits of improved comfort, safety and/or energy conservation.

Hip dysplasia occurs with increased frequency at higher GMFCS levels due to the strong adductor tone predisposing the hip to subluxation and dislocation.[11] Hip displacement may cause pain and osteoarthritic changes that lead to loss of ability to weight bear, impacting a range of activities from walking to standing programs. This can greatly impact the level of independence by increasing the need for assistance or being unable to access stairs or inaccessible areas at home through walking or crawling. Treatment options include BoTN-A injections to hip adductors, hypertonia management, nighttime use of a hip abduction orthosis, intra-articular joint injections, multi-level hip surgery or total hip arthroplasty.

Adults with greater functional limitations, GMFCS level IV and V, are also at increased risk of severe scoliosis.[12] Scoliosis tends to progress with age even after skeletal maturity.[13] Large spinal curves are associated with poor sitting, increased support requirements and pressure areas. Treatment includes conservative measures of customized seating or bracing with a thoracolumbar-sacral orthosis (TLSO). These supports allow upright sitting, distribution of pressures and accommodation of fixed deformities but it is not known if they impact curve progression during adulthood.[12] Surgical correction is done through a variety of spinal instrumentation techniques. Significant consideration is required when exploring surgery as people with CP, GMFCS level IV and V, have many other health concerns.[7,12] This makes the decision to have surgery a difficult one which causes surgery to be delayed resulting in larger curves at the time of repair.

Low back pain may be attributed to spondylolysis. This condition appears to be related to stress fractures through the pars interarticularis from repetitive hyperextension. Individuals with dystonia are at increased risk due to involuntary movements of lumbosacral spine into extension and rotation.[11] Logically, anterior pelvic tilt related to tight hip flexors, aggressive hamstring lengthening or selective dorsal root rhizotomy also increases the risk of lumbar spine stress fractures. Conservative treatments include Botox or hypertonia management to improve spinal alignment, mobility aids and exercise. In the event that conservative measures are not effective segmental fusion should be considered.

Adults with CP are experiencing changes in their function related to secondary complications as well as the aging process. They require guidance to navigate this new phase of their lives. To best meet the needs of this aging group, an increased level of expertise as well as a coordinated approach from health professionals must be present allowing adults to feel as supported as they were while children. GMFCS levels should be used while tracking factors that impact function along with the effects of aging. Research needs to be done to collate this information to provide a better picture of aging with CP. In the meantime, by listening to adults with CP describe their experiences and goals, there can be ongoing improvements in care.

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C5: The Paediatric Positioning Puzzle: Balancing Support with Function

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When considering seating and mobility systems for young children with progressive conditions there must be a balance between providing postural support to promote balance, stability and alignment and allowing what limited movement the client has for function.

Progressive Conditions in Paediatrics (as discussed in this presentation)

- Typical diagnosis and presentation
- DMD, SMA, FA, Congenital MD, CMT
- Other genetic, metabolic, orthopaedic
- Rate of progression
- Contraindications
- Role and scope of OT with equipment
- 24 hour positioning
- compensatory vs remedial therapy

Positioning and Seating

Relevance to function

- Access to controls
- Orthopaedic issues
- Proximal stability for distal mobility
- Propulsion
- Skin integrity
- Sitting tolerance
- Endurance

Integrating Goals into function

Considerations

Age guideline considering typical developmental stages (under 2)
Function - level of independence
Stage of diagnosis - Prediction of progression rate
Environment and access

Early Prescription of Power Mobility

Benefits

- Developmental: social, language, cognitive, conceptual
- Independence - positioning and propulsion, accomplishment/self-esteem
- Caregiver impact
- Fun and Play
- Participation and Inclusion
- Access: technology, environmental

Approach and Support to the Puzzle

- OT to assess for appropriate device
- Proactive prescription
- Consult with vendor/technician, problem solve solutions
- Consult with other professional: CWAS, specialty designs

Summary

- Incorporating therapy goals into prescription
- Positioning to maximize function without encouraging destructive postures
- Team problem solving approach - establish priorities, goals
- Consideration of all environments, developmental stages and factors
- Family/caregiver education

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Learning Objectives

1. Participants will identify 3 therapeutic goals of children with neuromuscular conditions.
2. Participants will identify 3 benefits of positioning related to independent mobility.
3. Participants will identify the assessment process and how it relates to the prescription of mobility and seating equipment.

C6: You Got To Move It, Move It! Pressure Relief Behaviors and Weight Shifting Activities to Prevent Pressure Ulcers in Persons with SCI

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I, Sharon Sonenblum, have received travel support from Ride Designs for this presentation. Other than this travel support, I have no affiliation with any equipment, medical device, or communications organization. I cannot identify any conflict of interest related to this presentation.

I, Trevor Dyson-Hudson, do not have an affiliation (financial or otherwise) with an equipment, medical device or communications organization. I cannot identify any conflict of interest.

Reduced mobility and impaired sensation combine to make pressure ulcers (PrU) one of the most common and costly secondary medical complications in persons with spinal cord injury (SCI)[1]. Because individuals with SCI who use wheelchairs for mobility are at increased risk of developing sitting-acquired pressure ulcers[2,3], they are provided with clinical interventions designed to prevent pressure ulcers. These clinical interventions are based upon the premise that both the magnitude and duration of external loading are important[4,5]. Pressure magnitude is managed by the selection of wheelchair cushions, other supports, and the seated posture, while duration of pressure is addressed via the frequency of weight shifting activities while seated. As a consequence, wheelchair users with SCI are frequently taught by clinicians to perform pressure reliefs-designed to shift body weight off the buttocks[6].

Studies investigating PrU prevalence in SCI cohorts that include pressure relief behavior as a potential pressure ulcer risk factor, however, do not find pressure relief behavior or frequency to be associated with PrU occurrence[7-9]. There are two possible explanations for this finding. First, each of the studies relied on self-report measures of pressure relief practices; however, self-reported behavior is known to be highly unreliable. Second, protective weight shifting behaviors may include activities other than dedicated pressure reliefs. Indeed, many functional movements performed while seated in a wheelchair will also redistribute pressure off PrU risk sites.

The purpose of this instructional course is to: 1) illustrate the impact functional movements can have on seated pressure, blood flow, and tissue health; 2) describe how newly-injured and longer-term wheelchair using individuals with SCI move during everyday life (e.g. wheelchair usage, weight-shift activities); and 3) discuss the implications that knowing how people in wheelchairs move can have on designing and implementing clinical interventions (e.g. education, training, equipment).

A number of studies have demonstrated the influence of small, functional movements on ischial pressure, blood flow, temperature, and humidity. One study by Sonenblum et al.[10] measured ischial pressure and blood flow on the buttocks of 19 people with SCI across 6 different postures including upright, two magnitudes of side leans and 3 front leans. Significant pressure reductions occurred at all leans except for the small front lean, with the full leans reducing the pressures most (reduction of more than 70%) and intermediate leans reducing upright pressures by 30-50%. Similarly, all leans except for small front leans resulted in a significant increase in superficial blood flow. Smit et al. also found pressure reduction and blood flow increases with front and sideward leans[11].

Results from a power tilt-in-space wheelchair were similar. Tilts as small as 15 degrees provided at least modest increases in blood flow, while tilts past 30 degrees offered decreased pressure and increased blood flow[12]. Another study demonstrated significant drops in temperature and humidity at the cushion surface when the wheelchair user transfers off the wheelchair, meaning the cushion is cooler and drier upon return to the wheelchair. Frequent weight shifting also may provide short term reductions in humidity while potentially slowing the cushion warming that occurs in a static sitting situation[13].

While the results above demonstrate the benefits of in-seat movement for individuals who use wheelchairs for mobility, they do not address what movement actually occurs. Research led by Georgia Tech, in collaborations with Shepherd Center, Duke University and Kessler Foundation, has investigated this question. Across 356 days and 30 participants studied within their first 4 months following SCI, participants spent an average of 8.1 (SD=2.7) hours per day in their wheelchairs. This was significantly less than the 10.6 hours per day spent in the wheelchair by individuals who had been using a wheelchair for more than 2 years[14]. In addition to the 356 days described, there were another 86 days studied where users with recent injuries spent fewer than 4 hours in their wheelchair, but we studied these days separately as they were not considered "full-time" use. Interestingly, despite spending fewer hours in the wheelchair, individuals with new injuries transferred out of their wheelchair more often than those with chronic injuries (injury duration ≥2 yrs) (9.4 times versus 8.4), suggesting they transfer more frequently when seated in the wheelchair. Note that this also means that new users are performing a total of nearly 19 transfers per day when transfers back to their chair are included.

This research also investigated the weight shift and pressure relief behaviors of participants. In addition to transferring more frequently, individuals with recent injuries also performed more frequent full pressure reliefs (i.e., complete unloading of the buttocks, Mean [SD] = 1.1 [1.3] per hour of occupancy) and weight shifts (i.e., partial unloading of the buttocks, 3.4 [3.5] per hour of occupancy), than individuals with chronic injuries (0.4 [0.5] and 2.4 [2.2], respectively). But amongst people with long term injuries, those with a history of recurrent pressure ulcers performed weight shifts significantly less often than individuals with no history of recurrent pressure ulcers (1.0 [1.6] versus 2.5 [3.3], respectively). This is the first evidence available to support the role of weight shifts in preventing pressure ulcers.

As you might expect, individuals recently discharged home from acute rehab used their wheelchairs quite differently than individuals with chronic injuries. In addition to the reduced time in chair as described previously, individuals with recent injuries wheeled less than 70% of the distance, time and bouts of people with chronic injuries. Specifically, individuals with recent injuries wheeled a total of 56 (31) bouts, traveling 1.1 (1.0) km per day over 35 (34) minutes. In this population, only 7.6 (4.5) % of the time individuals spent seated in their wheelchair was spent wheeling.

These data are the first to begin to articulate how people move with and within their wheelchairs, and highlight some of the dramatic differences in movement between someone recently discharged with an SCI and someone who has been living with an SCI for many years. Clinically, it is important to recognize the changes in behavior and how they might impact equipment and intervention needs. Furthermore, the data on in-seat movement illustrate that individuals do not perform regular pressure reliefs as prescribed, but their tissue may in fact benefit from functional movements that result in weight shifts.

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D1: Tune Up Time: Optimizing Function and Performance

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Matt Lowell does have an affiliation with Sunrise Medical as a volunteer member of their clinical advisory board. There are no financial ties associated.

Our presentation intends to address the common opportunities we experience in daily clinical practice to improve the mechanical and dynamic performance of manual wheelchair mobility. In our experience we often work with clients who either through lack of routine maintenance and upkeep, or less than ideal setup and positioning do not experience optimum function from their equipment. While our presentation is not intended to cover every possible scenario, we have addressed many of the key areas we find in our program that can significantly improve an individuals mobility and performance from their manual wheelchair.

Working in the field of wheelchair prescription, fitting, maintenance and repair there are several key elements needed. We have had success utilizing a space for clinical evaluations, fittings and repairs (located in our orthopedic specialty hospital), while also maintaining a separate fabrication area and tool shop. Our program works with children from birth to their 21st birthday and is sponsored through private donation for unfunded equipment needs. We also work closely with local vendors to supply equipment in a more conventional medical model utilizing clients' insurance. As such we often are involved with not only the assessment and fitting but also with wheelchair seating and mobility equipment purchasing and repairs.[1]

Many of our repairs and maintenance are performed on a routine schedule with periodic follow-up appointments. Keeping the equipment in good working order allows our clients to maximize their function and activity. Focusing on common issues such as caster and rear wheel alignment, bearing maintenance, brake adjustments and routine care and maintenance we can extend the usefulness of equipment and the satisfaction our clients have with its performance.

Another key component to best use is the set up and positioning of the client relative to the equipment and its intended function.[2] Evaluating axle position, (center of gravity settings) frame length and fit, weight, wheelchair accessories and options are critical to both function and client satisfaction.[3] Demonstrating techniques and approaches to the "high performance" tune up can allow clients greater efficiency and access in their lives.[4]

Our discussion along with the use of pre-recorded videos will convey techniques, tools and an awareness for when you should grab a wrench or pursue follow up.[5] Addressing the technical needs of your clients' equipment will help improve their quality of life and maximize their function.

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D2: My First Wheels: An evaluation of a novel powered mobility device for use in early intervention

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I, Scott Langmead have an affiliation with Designability (United Kingdom) and the distribution by Ability Centre of the Wizzybug mobility device in Australia and New Zealand within the past two calendar years. This provides no direct financial benefit to myself.

Introduction
At the time this evaluation there were no specifically designed powered first mobility options for children of early intervention age available in Australia.

The evaluation of a novel device; the Wizzybug, in an Australian context was indicated.

Some benefits of early powered mobility;
The use of powered mobility is supported to enhance development and function in children as young as 14 months.[1]

Research of self-produced locomotion in typically developing infants view mobility as an organiser of psychological changes in infants and developmental changes in social understanding, spatial cognition and communication.[2]

Children as young as 23 months have been taught to use a powered mobility device independently.[3]

Powered mobility has increasingly been advocated for children with severe motor impairments. Children who are immobile are at risk of secondary impairments.[4]

Focus Points

1. Device factors such as ease of use, durability, appropriate speed, and aesthetics were valued by parents.

2. A first mobility device facilitates enjoyable self-initiated exploration opportunities for young children with associated benefits of movement evidenced at varying levels of user competence.

3. Parents' initial evaluation of a mobility device's properties and relevance for their child are reliable predictors over time.

Critical Justification
Parents are the central voice and gatekeeper to a variety of therapeutic modalities for a child with disability. This evaluation focused on several aspects of early powered mobility access; quantitative feedback regarding the device itself, the impact of use of the device on the child and their peers, and qualitative parent perspectives of device use over time.

As the Wizzybug had never been used in an Australian context, evaluation of its appropriateness for the Australian environment and potential benefit to the child was completed as part of the evaluation cycle and ongoing creation of an evidence base for first mobility device use.

The provision of early mobility experiences should have some direct benefit developmentally and experientially for the child. Several significant effects of device use were observed by parents including; enjoyment of movement, spontaneous vocalisation, interaction with others and exploration of their environment.

Experiences of first powered mobility in the device were viewed as beneficial to the child regardless of their level of competence.

Concluding Message

Overall, the Wizzybug was viewed by parents as a device enabling positive first powered mobility experience for users with a variety of disabilities.

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Websites

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http://www.designability.org.uk/product/wizzybug/ [Accessed 15/1/2016]

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D3: Shoulder Evaluation and Intervention for Manual Wheelchair Users

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The authors have/had an affiliation (financial or otherwise) with an equipment, medical device or communications organization during the past two calendar years. Specifically, Invacare, Corp has funded research projects at The Ohio State University.

Introduction
Upper extremity injuries are prevalent with individuals who use a manual wheelchair. Studies have shown that 31-73% of manual wheelchair users experience shoulder pain due to the demands of wheelchair propulsion, in combination with the weight-bearing requirements of transfers and ADLS[1]. Pain limits completion of self-care activities, work and social participation. Often, shoulder dysfunction leads to a transition from manual mobility to power mobility as a result of challenges with manual propulsion. The majority of my clients fear and avoid surgical intervention for their upper extremity deficits due to the corresponding restrictions in activity post-surgery and resulting further loss of independence. Research has found that only 2% of this population undergoes shoulder surgery treatment for rotator cuff tear and shoulder disability (out of 60% who reported pain) [2].

Few clinicians are trained to prevent, educate and establish wellness programs, or assess the demands specific to individuals who use a manual wheelchair as their primary mode of mobility. Specialized seating clinicians can be the front line of defense for individuals who use manual wheelchairs in terms of shoulder health and wellness.

Shoulder Evaluation
An understanding of shoulder pathologies frequently encountered with manual wheelchair users due to overuse is required to provide intervention and educate on prevention of further disability. Risk for rotator cuff pathology, activity modification, and basics of wheelchair configuration have been established through Paralyzed Veterans of America's: Preservation of Upper Limb Function Following Spinal Cord Injury,

A Clinical Practice Guideline for Health-Care Professionals[3]. The ability to complete a thorough shoulder screening aides in identifying and localizing dysfunction. A clinician's "tool box" should include competency with special tests to specify dysfunction via clinical prediction rules. The shoulder dysfunction is typically described as cervical radiculopathy, sub acromial impingement syndrome, and acromial clavicular joint pathology. Other groupings of shoulder special tests rule in or out labral pathologies and rotator cuff tears. Specific outcome measures aide in establishing baseline disability for review pre and post intervention. Recommended outcome measures are the Disability of the Arm, Shoulder, and Hand (DASH), Kerlan-Jobe Orthopaedic Clinic Functional Assessment for Overhead Athlete, Shoulder Pain and Disability Index (SPADI), and Wheelchair User's Shoulder Pain Index (WUSPI)[4]. These outcome measures are of benefit for tracking progress with rehabilitation. These tools also assess impact of wheelchair modifications and training. Client education of assessed risk identified with screening and results of outcome measures can aide in participation and follow through with rehabilitation process.

Shoulder Intervention

A clinician's ability to localize dysfunction is only one piece of the puzzle. The ability to provide evidence based intervention strategies for flexibility, strength, and equipment configuration is key. Timely and appropriately advanced interventions optimize independence with daily activities, wellness and participation in sports. Interventions in a staged approach have been recommended for non-wheelchair related orthopedic injuries, as well as wheelchair recreation and sports related injuries. The staged approach includes: pain free active range of motion, muscle strength symmetry around joint, cervical and scapular stability, and advancement to resisted movements by route of dynamic stabilization, eccentric exercise, and plyometric exercise.[3,5-7] These interventions can be used for general wellness and pain prevention as well.

Case studies assist in clinical application of screening, intervention, and return to goal directed activities. Clinical application of optimized wheelchair configuration, targeted modifications, objective measures, and follow up training are recommended to coincide with rehabilitation of the shoulder. Key questions to assist in modification to current or prescription of a new manual wheelchair include:

- Transfer style: floor, uneven height, approach angle
- Lifestyle: work, home, community, family
- Driving: transfers, vehicle controls
- Fears: stability
- Mobility activity: sports, recreation
- Non-mobility activity: access to counters, shelves, floors, tables
- Environment: tile, carpet, grass, gravel, concrete, hills
- Spasticity: pelvis and lower extremity positioning
- Skin: past and present integrity
- Pressure: relief strategies, monitoring

Outcome tools are beneficial to assist in modification to or prescription of a new manual wheelchair. Examples of tools used in our clinic include:

1. To establish skill level=manual wheelchair skills test[8]

2. Propulsion analysis compared to normative data=Smart Wheel assessment[9] with education on optimal technique[10-12]

3. Balance assessment=backward lean=tippy test[11], reach to floor, weight distribution on castors vs. entire frame[13]

4. Pressure mapping-assess optimal pressure relief strategies with goal to decrease repetition of gleno humeral joint compression meaning to avoid push ups[3]

Conclusion

The daily tasks encountered by individuals who use a manual wheelchair, specifically propulsion and transfers, are very repetitive and lead to trauma both acutely and chronically. Increased functional independence, and ease of transportation, along with decreased financial costs are benefits of shoulder evaluation and intervention. These clinical strategies, in addition to optimizing the manual wheelchair set-up, will increase an individuals health and wellness. The strategies may allow them to delay a transition from a manual wheelchair to a power wheelchair, even after the occurrence of a shoulder injury. A shoulder evaluation and intervention program applied to individuals who use a manual wheelchair utilizes the skills, knowledge and training of clinicians to minimize acute and chronic shoulder pain and injury.

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D4: What's New in Medicare Reimbursement?

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Policy changes, clarifications, legislative initiatives, new programs,...it is difficult to keep up with everything going on in the Medicare reimbursement world. But as clinicians and providers it is imperative to stay informed in order to ensure that clients receive appropriate equipment and that payments are secured and retained. The following is a review of the issues currently affecting access to seating and wheeled mobility equipment in the U.S. Please note that all information was current as of 02-11-16.

Competitive Bidding (CB)

Unfortunately, CMS has made no changes to correct the many issues with the flawed Competitive Bidding program despite extensive feedback from industry and non-industry experts over the last 8 years. This has forced us to seek legislative action. In April 2015 we were able to gain a small victory through an add-on to the "Doc Fix" bill. This provision requires that <u>before</u> suppliers submit a bid for an item under a CB program they must prove that they have all applicable licenses required by their state to provide that item. They are also required to obtain a bid bond, which will be forfeited if they are offered a contract that they then decline. Although this is a step in the right direction, it will unfortunately begin no earlier than January 2017.

In the meantime, CMS published Final Rule 1614-F, again despite many objections and comments from stakeholders. This rule established new payment amounts in <u>all</u> geographic areas that are not in a CB program. The payment amounts are for products that are included in CB programs, such as standard manual wheelchairs (MWCs), standard power wheelchairs (PWCs), Group 2 complex rehab PWCs and POVs.

Basically, CMS divided the country into 8 distinct regions. In each region they took the single payments amounts (SPAs) that were being paid for a particular product under the CB programs in that region and calculated an unweighted average. This became the regional single payment amount (RSPA) for that product in the "non-bid" areas of that region, replacing the previous fee schedules (allowables). No RSPA could be greater than 10% above or less than 10% below the combined average of all RSPAs (this set a "ceiling" and a "floor"). The RSPA for rural areas was set at the ceiling. The RSPAs will be used as bid caps for future rounds of CB. CMS established a "phase-in" of the new payments such that from Jan 1 - July 1 payments will be a 50/50 blend of the 2015 allowables and the RSPAs. Beginning July 1, payments will convert to RSPAs only.

The final rule expands CB pricing throughout the country and forces drastic cuts in payments (as high as 40-50%) for many DME products. In addition, the new payment amounts for suppliers in the previous non-bid areas are based on payment amounts over which they had no control (e.g., payment amounts that were accepted by suppliers who bid in the CB programs in surrounding areas). In many cases these payments were based on unsustainable bids and/or bids by out-of-state suppliers.

Once again, we have been forced to go to Congress and they have supported us in the House by introducting **HR 4185** (Protecting Access through Competitive Pricing Transition Act) and in the Senate by **S 2312** (DME Access and Stabilization Act). Both bills mandate that CMS (1) apply a 30% increase to the RSPAs for the non-CB areas (2) phase in the new payments over 2 years to allow suppliers to adjust and Congress to review (3) use the fee schedule from 2015 for the bid cap for future CB rounds and (4) revisit pricing for non-bid areas to account for travel distance, clearing price and other associated costs when setting 2019 prices. HR 4185 would also implement a Market Pricing Program (MPP) that would use standard bidding program methodology, require binding bids, weigh historic capacity of the bidders, and establish payment amounts based on clearing price of all valid bids. It would ensure transparency and be monitored by qualified and experienced experts.

CRT Accessories

Another major problem with the Final Rule for the expansion of CB is that it included accessories used on complex rehab technology (CRT) wheelchairs. Prior to January 2016, accessories provided on standard wheelchairs in a CB area were paid the CB SPA. However, if the same accessory was provided on a CRT wheelchair it was paid the fee schedule. Under the Final Rule, <u>all</u> accessories are to be paid the RSPA no matter what the base is. This means that payment for accessories on CRT wheelchairs will be derived from bids for accessories used on standard DME. Approximately 171 accessory codes are affected including trays, arm troughs, head supports, lateral and medial hip and trunk supports, anterior trunk and pelvic supports, power seating, alternative drive controls, all seat cushions and back supports, and many more.

CMS has no authority to do this. First, it is beyond scope of the final rule. It also violates the intent of Congress when they passed the Medicare Improvements for Patients and Providers Act of 2008 (MIPPA) in 2008, which exempted CRT PWCs <u>and</u> their accessories from CB. And it is contrary to CMS's own policies prior to 2016 which excluded CRT MWCs and CRT accessories from CB.

In April 2015, the House sent a bipartisan letter to CMS signed by 101 Representatives requesting CMS to issue written clarification that accessories used with CRT PWCs and MWCs continue to be paid at the fee schedule. In August 2015, 25 Senators signed a similar bipartisan letter. Unfortunately, CMS responded that they did not intend to change their policy or follow Congressional recommendation.

Congress reacted with **HR 3229** and **S 2196** "Bill to Amend Title XVIII of The Social Security Act to Provide for the Non-Application of Medicare Competitive Acquisition Rates to Complex Rehabilitative Wheelchairs and Accessories". These bills legislate a technical correction to clarify the exemption of CRT WC accessories from CB and prevent CMS from applying CB pricing. Unfortunately, this was not included in the omnibus spending package at the end of 2015, however, it is still active for 2016.

We did achieve some measure of success in December 2015 when **S 2425** The Patient Access and Medicare Protection Act (**PAMPA**) was the last bill signed in the last hour of the last session of Congress. The bill, effective 01-01-16, mandates a 1-year delay of the funding cuts established by the final rule for CRT accessories. This would keep payments for CRT accessories at the 2015 fee schedule until at least January 2017. It also calls for the Government Accounting Office (GAO) to publish a report by June 1, 2016 with an analysis of the accessory codes and their descriptions, the total payments and utilization of these codes, and a comparison of the RSPAs to the fee schedule payments. Although this should be encouraging legislation, there are some issues.

First, the bill only includes accessories provided on Group 3 PWCs, but does not include those provided on any other types of wheelchairs. In addition, CMS has announced that they cannot implement the law until July 1, 2016. As such, for all applicable claims submitted between January 1 and July 1, accessories provided on Group 3 CRT PWCs will be underpaid at the RSPA established under CMS's final rule 1614-F. After July 1, any new claims will be paid the correct amount. Once CMS implements the law suppliers will be allowed to resubmit the claims paid from January to July to receive the difference between the RSPA and the corrected fee schedule. This payment adjustment will not be automatic. Suppliers must resubmit the claims to Medicare and to any secondary insurers to finally receive full payment.

This delay in full payment for accessories provided on CRT PWCS violates the intent of PAMPA and unfairly burdens suppliers with reduced payments. It is also unreasonable to require suppliers to bear the cost and effort to resubmit 6 months of claims to both Medicare and secondary insurers to get payment adjustments. This significantly compromises their ability to provide accessories on CRT WCs and will significantly reduce beneficiary access. CMS blames logistics for their inability to go back to the fee schedule, however, they were aware of PAMPA in December and they have made many other policy changes in a much shorter time.

Prior Authorization

In 2012, CMS initiated a 3-year Prior Authorization Demo Project in 7 states. Under this project, suppliers were required to submit documentation for certain power mobility devices (PMD) for prior approval (PA) before submitting a claim. All coverage criteria and documentation requirements remained the same. In 2014 it was expanded to 12 additional states and in 2015 both demos were extended through August 2018.

This is one project that has been deemed a success by CMS <u>and</u> the supplier and clinical communities. CMS feels that it has reduced inappropriate utilization. Suppliers are happy to be informed as to whether or not the documentation is sufficient and coverage criteria is met <u>before</u> delivery and claims submission. It provides the supplier with some assurance of payment, and some assurance that claims with positive decisions will be protected from future audits. If a negative determination is made, the beneficiary, the clinician and the supplier are all told why and the supplier can resubmit an unlimited number of times with additional documentation.

Based on the success of the demo project, CMS published another Final Rule in December of 2015 to expand the PA process across the country and to include additional DME. The rule proposed a "master list" of 135 items that have an average purchase fee greater than or equal to $1,000 or an average rental fee greater than or equal to $100 and, according to CMS, have high ("unnecessary") utilization. The initial list included K0004 MWCs and K0813 - K0864 PWCs. Although the final rule indicated that this program would begin within 60 days after publication (Feb 29, 2016), as of this date (Feb 11, 2016) they have not published the exact start date, an exact list of included items or the exact time frames for responses.

Separate Benefit Category for CRT

Last but certainly not least, we are still seeking passage of HR 1516 and S 1013. These bills would require CMS to establish a separate category for CRT within the DMEPOS benefit, similar to orthotics and prosthetics. CMS would be required to (1) separate and/or create new HCPCs codes for CRT wheelchairs and accessories, (2) eliminate the in-home restriction for CRT, (3) increase supplier standards for CRT, (4) create more functional coverage criteria, (5) allow provision of CRT in a SNF if required for transition to the home, and (6) clarify exemption of CRT from CB. In the long run, this is perhaps the most important piece of legislation since it would prevent CRT from being included in any further policy changes and programs that target standard DME.

So…….do you want your clients to have continued access to the products that they need for independence and health? Do you want to continue to provide the most appropriate products and be appropriately reimbursed? Then we need your support! Go to www.access2crt.org or www.protectmymobility.org. Use the resources on these sites to familiarize yourself with the issues and the talking points. Check to see if your legislators have signed on to these important bills (HR 4185 and S 2312; HR 3229 and S 2196; and HR 1516 and S 1013). Learn how to contact them. If they have not signed on, ask them to do so. If they have signed on, thank them. In either case, ask for their support when the bills come up for a vote. Be informative and be persistent.

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D5: "A Day in the Life" At Home Complex Rehab Equipment Evaluations: An Individualized Process

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This course was inspired by providing complex Neurorehab therapy, wheelchair and AT evaluations in the home. Interviews and feedback from the patient, family and caregivers indicates that there are areas for improvement in our service delivery and evaluation process. The advantage of specialized outpatient therapy in the home is the value of a true perspective in the environment in which the patient needs to function. ALS, MS and ABI case studies using videos, pictures and patient, family and caregiver interviews will help them in the equipment prescription process.

For those who specialize in the area of Wheeled Seating and Mobility and Assistive Technology, a clinical model where the equipment selection occurs at a rehab center, whether inpatient or an outpatient wheelchair clinic, does have the advantage of access to multiple manufacturers' products. The challenge remains in assuring how that equipment will match the individual's specific needs with regard to their lifestyle, activity pattern, other adaptive equipment in the home, environmental considerations, navigation, and transfers to name a few. There are further considerations such as multiple caregivers, integration of equipment relative to one another, all seat surfaces with regard to positioning, pressure and function, and education on differentiation of product. Further, positioning and pressure goes beyond the wheelchair to the other support surfaces the patient has in the home. The case studies will include pressure management beyond the wheelchair for comprehensive pressure management education.

Patients and family members have shared the challenges they have incurred during the prescription and recommendation process regarding these issues. The patient after having been home, can begin to self-evaluate their daily needs will have valuable input as part of the prescription process which may affect the specific selection of equipment. The focus of this course is to learn from those we serve, and utilize the feedback to improve the effectiveness of our service delivery.

Learning Objectives

1. Evaluate the individuals rehab equip needs specific to their environment, activity pattern and multiple support surfaces with regard to positioning and pressure.

2. Recognize the patient/family/caregiver needs in education about equipment and funding options.

3. Integrate all mobility and AT equipment needs with respect to each other to meet the patient's needs.

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D6: Seating and Mobility for the Oncology Patient

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Introduction
Oncology patients have a variety of ongoing medical needs. The side effects of treatment for certain types of cancers can be very debilitating and affect a variety of mobility related activities of daily living. Often these patients require assistive devices, but they are not prescribed appropriately due to the lack of knowledge on the part of medical and radiation oncologists. Sometimes patients may never encounter a rehab professional throughout their treatment. However, with the increase in visibility of cancer rehabilitation, these patients' mobility needs are being more adequately assessed. It is important for those delivering assistive technology to be knowledgeable of the side effects of cancer treatment, as well as the possibly assistive technology needs of these complex patients.

Discussion
Cancer rehabilitation is becoming a more recognized subspecialty of physical therapy and occupational therapy service delivery. Rehab professionals can come into contact with the oncology patient at any point during their cancer treatment. This can be presurgically, post surgically, during chemotherapy, radiation, or sometimes not until well after their cancer treatment has been completed. At each stage of their cancer treatment, different mobility issues can become more prevalent. The following discussion will look at the most prevalent types of cancer, their typical treatment pathways, and the accompanying mobility deficits that are common to that type of cancer and its treatment.

Types of Cancer:

- Breast
    - » Course of treatment:
        - Surgical (lumpectomy, partial mastectomy, unilateral or bilateral mastectomy)
        -Chemotherapy- adreamyacin, cytoxin, Taxol
        -Radiation therapy
        -Reconstructive surgery
    - » Possible musculoskeletal side effects:
        -Shoulder muscle weakness/impairment
        -Chest wall weakness/impairment
        -Peripheral neuropathy in hands, feet, pelvis
        -Frozen shoulder

- Lung
  - » Course of treatment:
    - -Surgical (thoracotomy, chest tube, possible lung removal or lung transplant)
    - -Chemotherapy
  - » Possible musculoskeletal side effects:
    - -Decreased endurance
    - -Paralyzed diaphragm
    - -Peripheral neuropathy
    - -Cardiopulmonary complications
    - -Poor shoulder functioning
    - -Trunk weakness
    - -Poor balance and pelvic weakness

- Colorectal
  - » Course of treatment:
    - -Surgical (colectomy; either partial or full)
    - -Chemotherapy (either internal during surgery or post surgical)
  - » Possible musculoskeletal side effects:
    - -Decreased trunk control and weakness
    - -Decreased endurance
    - -Poor pelvic control and balance
    - -Peripheral neuropathy
    - -Incontinence

- Brain
  - » Course of treatment:
    - -Surgical resection (gamma knife, craniotomy)
    - -Chemotherapy
    - -Radiation
  - » Possible musculoskeletal side effects:
    - -Weakness
    - -Neurologic deficits
    - -Blindness
    - -Proprioceptive issues
    - -Balance difficulties

- Implications for assistive technology
  - » No typical timeline for side effects from treatment to appear
  - » Patients are often too debilitated for a manual chair or are unable to wheel a manual chair, but side effects are temporary so they are hesitant to procure a power wheelchair
  - » Patients may require multiple forms of assistive technology throughout their course of treatment
  - » Surgical restrictions may have major implications for type of assistive device

- Side effects from chemotherapy can persist for up to two years after chemotherapy has ceased
- If patients are receiving cancer rehabilitation during their treatment, they may have the potential for physical improvement

- Assistive technology evaluation for the oncology patient
  - Subjective
    -Type of cancer
    -Course of treatment (both current and future)
    -Prior musculoskeletal deficits
    -Current MRADL issues
    -Fatigue level
    -Activities that they would like to return to

  - Objective
    -FACT-G
    -Range of motion/strength assessments
    -Cardiopulmonary endurance
    -Balance tests
    -Gait tests
    -Wheelchair trials

- Assessment
    -Look at current mobility level vs what treatment the patient still has left
    -Compare current mobility status with prior mobility status
    -Often these patients will not physically be able to wheel a manual wheelchair, so looking at the most appropriate type of power chair is generally what you will be evaluating
    -Must also look at cancer prognosis to decide most appropriate mobility device

Conclusion

Evaluating a cancer patient for a mobility device can be difficult. It requires a team effort with the physicians and therapists that are treating the patient to allow for an accurate prognosis. As with any progressive disease, it is important to consider where the patient's functional level is likely going to be in 6 months to a year prior to deciding on an appropriate mobility device. This requires an adequate knowledge of the type of cancer that the patient has as well as their course of treatment and its side effects. These patients can be complicated to prescribe mobility devices for due to the ongoing change in medical status, however an assistive technology provider should be an integral part of the oncology team.

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E1: The Donation of Wheelchairs [illegible] a Customized and Functional Postural System is a Social [illegible] That Strengthens the Dignity of People with Disabilities. [illegible]tudy: Impact on Costa Rica Rural Areas

CANCELLED

Shirley Pereira

E2: CanWheel: Improving Power Wheeled Mobility for Older Canadians

William Miller and the CanWheel Research Team
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We (William Miller, Paula Rushton, R Lee Kirby, William (Ben) Mortenson, Pooja Viswanathan, and Francois Routhier,) do not have an affiliation (financial or otherwise) with an equipment, medical device or communications organization.

Introduction

Mobility impairment is the most prevalent form of disability for Canadians 60 years of age and older[1] and, with the aging baby boom population, the number of older Canadians living with mobility impairments will grow exponentially over the next 40 years. Those who are unable to ambulate functionally, wheeled mobility may become necessary and those who are unable to propel a manual wheelchair may require power mobility. In 2012, there were approximately 288,800 community-dwelling wheelchair users aged 15 and over in Canada, 42,360 being powered wheelchair (PWCs) users[2]. PWCs are an expensive yet important form of assistive technology that can compensate for impaired mobility. These devices can have a positive impact on the quality of life of older adults by improving self-esteem, well-being, reducing pain and discomfort, and enhancing activity performance, participation, and independence[3-6]. However, they are far from perfect in terms of their functionality, safety, and cost-effectiveness[4,7,8]. In addition to functional difficulties such as difficulty maneuvering in indoor spaces and difficulty transporting the power wheelchair[4], cognitive impairment can also restrict the usefulness of power wheelchairs for some users. Safety is also a concern[8]. For these reasons, it is critical to ensure that these devices meet users' needs and skill levels.

Focus

The CanWheel Team was formed in 2009 to improve the mobility opportunities of older adults who use or might benefit from power wheelchairs. CanWheel is comprised of 18 scientists and clinical researchers, as well as 16 trainees, from 6 institutions across Canada. Our program of research, funded by a six-year Canadian Institutes of Health Research Emerging Team grant (AMG-100925), has addressed three basic questions: (1) How are PWCs used now?; (2) How can PWCs be used better?; and (3) How can PWCs be better?

Approach

CanWheel has applied a mixed-methods approach (lab-based, qualitative, and quantitative methodologies) spanning five key research projects:

Project I – Evaluating the Needs & Experiences of Older Power Wheelchairs Users

- This project evaluated the effectiveness, impact, and relevance of power wheelchairs from the perspective of older adults, caregivers, health care providers, policy makers, and funding agencies.

Project II – The Natural History and Measurement of Power Mobility Outcomes

- This project described the trajectory of mobility status over time in older PWC users with an outcome measures toolkit of subjective and objective measures.

Project III – Strategies and Platforms for Collaboratively-Controlled, Environmentally-Aware Wheelchair Innovation

- This project continues to develop and assess innovations (e.g. collaborative PWC functions, i.e., mediation by a computerized system on the PWC which is aware of the environment and can collaborate with the user to achieve mobility goals and avoid dangerous situations) to maintain and restore wheeled mobility.

Project IV – Activity and Status Monitoring System (Data Logger)

- This project aimed to identify and describe the most common data loggers and their underlying technology features used to measure wheelchair use and activity, as well as physiological characteristics of wheelchair users.

Project V – Evaluation of the Safety, Efficacy and Impact of the Wheelchair-Skills Program for Power Mobility Users and Their Caregivers

- This project evaluated the effectiveness of the Wheelchair Skills Training Program for PWC users[9] in improving wheelchair skills capacity, confidence and satisfaction[10]. An assessment of the nature and extent to which caregivers contribute to the PWC mobility of users is currently in progress.

The findings of the CanWheel Team have enhanced our understanding of how PWCs are used, how these devices can be improved, and how an aging population can use them more effectively. Specifically, this research brought about a wheeled mobility outcome measures toolkit for older adults and contributed to the improvement and development of wheelchair skills training programs and intelligent wheelchair technology.

Take-home message

At the conclusion of this instructional session, attendees will have a deeper understanding of the health, functioning and quality of life of older adult PWC users, the challenges we have met along the way, and the current status of our program.

You will be able to:

1. Describe how PWC use changes over time and learners' experiences and perceptions of collaborative PWCs.

2. Describe current data-logger technology and what clinical and operational data can be collected on PWCs.

3. Describe how to apply a PWC training intervention based on the Wheelchair Skills Program.

CanWheel's results can inform both improved clinical practice today and research efforts tomorrow. www.canwheel.ca

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E3: Gait Trainers: Evidence based clinical practice guidelines

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I Ginny Paleg have worked as an educational consultant for various manufacturers of standers and gait trainers including Prime Engineering in the last two calendar years.

I, Roslyn Livingstone, do not have an affiliation with an equipment, medical device or communications organization.

For children, being able to move around and explore the world around them plays an important role in social and psychological development.[1] Children with cerebral palsy (CP) or other complex disorders are often less mobile and interactive than their peers and this can have a negative impact on their overall development.[2] Children functioning at Gross Motor Function Classification System (GMFCS)[3] levels IV and V are unable to use typical hand-held walkers due to decreased strength, trunk control, balance and range of motion. The term gait trainer means a supported walking device that provides trunk and pelvic support. They are often used with children with CP (and other related diagnoses) as well as those with severe visual or cognitive limitations. They may be used to influence different types of outcomes as defined by the International Classification of Functioning, Disability and Health (ICF).[4]

We completed a systematic review of the evidence regarding use of gait trainers at home or at school with children who are unable to walk independently or with hand-held walkers in November 2014.[5] A total of 17 studies were identified, but only four of these achieved American Academy of Cerebral Palsy and Developmental Medicine criteria[6] ratings of level II or level III. One small randomized controlled trial found a non-significant trend toward increased walking distance[7] for children with CP using gait trainers overground in comparison to children walking on a treadmill. A concurrent multiple baseline design study[8] reported increased number of steps in children with multiple and complex disabilities using gait trainers in school. Two non-randomized two-group studies were identified[9,10] and both measured a statistically significant impact on mobility level for children using gait trainers. One study[9] found a significant impact on bowel function in children who used the gait trainer rather than a standing frame, and there was an association with increased bone mineral density for those children who spent more time in either their standing frame or gait trainer.

Remaining studies were either case studies or case series and suggest that gait trainers can have a positive impact on a range of activity outcomes such as transfers, standing posture and ability, activities of daily living and level of independence. Some studies reported impact on affect, motivation and participation with others. The systematic review confirmed that while evidence supporting outcomes of gait trainer use is limited, there is even less evidence to support the selection of different gait trainer styles and features.

In order to add to the evidence base, a study to evaluate the inertial properties and forces required to initiate movement was completed in a laboratory setting.[11] The Prime Engineering KidWalk, Rifton Pacer and Snug Seat Mustang were compared on two different surfaces – carpet and tile. While the Pacer was the lightest overall and the KidWalk was the heaviest, the overall size and footprint of the three gait trainers were very similar. While 85% of the weight was borne on the large wheels of the mid-wheel drive KidWalk, weight was borne fairly evenly on the four casters of the Mustang and Pacer.

The differences in wheel and caster style, frame style and overall mass impacted the inertial properties and forces required to initiate movement. In these tests, initiation forces on tile appeared to be equivalent for the Pacer and KidWalk while the Mustang (with larger foam filled casters) had the highest initiation force. On carpet, the KidWalk with its large wheels was the easiest to move, while the gait trainers with four casters had higher initiation forces. We were unable to compare forces when turning due to differences in the frame style preventing the walkers being pulled from a similar location relative to the axis of rotation. Further studies comparing the impact of different frame, wheel and caster styles on gait trainer turning and maneuverability are needed.

Further studies are also needed to compare the features of different gait trainers and to assess the impact with different children. We wanted to explore the clinical question of which gait trainer is best for which child. We wanted clinicians to be able to match clinical needs with parameters of each device. To this end, we began by having 5 children walk the length of a “Gait Rite” mat in a Rifton Pacer and Prime Engineering KidWalk. A representative of the company assisted us in attempting to remove the wheels of the gait trainers, but the amount of raw data was too high and the software failed. The company and product have since undergone changes, and they believe they could be successful if this was repeated.

Instead, we obtained institutional research ethics approval and attempted to repeat this study more formally in a dedicated gait laboratory with a “double wide” gait mat manufactured by ProKinetics. We recruited children age 3-12 at GMFCS Level IV who were successful users of either a KidWalk or a Pacer in their home and/or school. Two children were tested using both devices. Again, no data was deemed usable. This time the problem was the lack of “heel strike”. Both children in both models of gait trainers pushed off with their toes with insufficient force to be recorded by the software.

For our next try, we will go to a gait lab with video analysis and try using this method. In the past, we had tried this and the gait trainer frame blocked the recording of the markers. We hope to be able to get usable data. As they say, fourth time is the charm… (they don’t say that, we are just eternal optimists…).

There are multiple factors that need to be considered when selecting gait trainers for individual children. Factors within the child such as muscle tone, movement patterns, strength and functional level are all important. Environmental factors such as location of use, transportation and storage use as well as type of transfer will all influence decision-making. Research is needed in all aspects of gait trainer assessment, selection, outcomes and implementation. We suggest that clinical consensus may be useful to providing guidance in decision-making around prescription and use of gait trainers and features for children with complex needs and hope to complete a survey of clinicians to provide an evidence base for the future development of clinical guidelines.

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E4: Prescribing the Right Pressure Management Equipment

Jo-Anne Chisholm, Joanne Yip

Jo-Anne Chisholm and Joanne Yip do not have an affiliation (financial or otherwise) with an equipment, medical device or communications organization.

Pressure management requires an interdisciplinary team approach. A clear understanding of the scope and skills of the team members, including points of intersection and overlap enhances the collaborative process and ultimately leads to better outcomes[1]. The utilization of a pressure management practice model helps define the role of the occupational therapist and wound nurse in prevention, treatment and monitoring of persons at risk for pressure wounds[2]. People using wheelchairs are at particularly high risk for developing pressure problems, and being able to objectively measure pressure of sitting surfaces using pressure mapping can help with clinical decision-making.[3]

In this one hour instructional session, participants will be introduced to a pressure management practice model developed by the authors; will learn about the use of pressure mapping in assessing and prescribing seating and positioning equipment; and will be introduced to examples of equipment used to solve pressure problems.

Objectives:

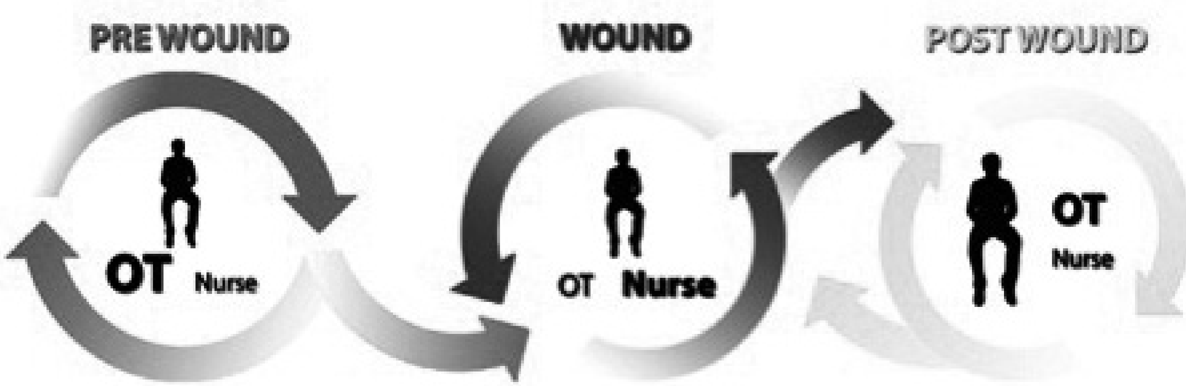
1. Describe a practice model for pressure management.

2. Explain the difference between pressure redistribution and force isolation in management of pressure.

3. Identify 2 ways pressure mapping augments assessment, prescription and provision of seating for a person at high risk of pressure.

In order to frame the OT and nursing role in pressure management the following practice model is used by Access Community Therapists where the client is represented by the sitting figure:

Pressure Management Practice Model for OT and RN



Chisholm/Yip 2008

The overarching goal in this model is to keep our high risk clients (think spinal cord injury, palliative, elderly bedbound) from ever moving out of the safe green "Pre Wound" zone. In this pure prevention phase, OT has the biggest role to play in firstly identification of higher risk clients, and prevention of wounds through the use of **education** on proven pressure prevention habits; prescription of medical **equipment** including cushions and mattresses; **postural** alignment in bed and wheelchair; **environmental** modifications and using the safest **methods** in transfers, repositioning, mobility and other functional activities.

If, in spite of best efforts, or because prevention was not initiated, the client develops a pressure wound (Red Wound Phase), then the OT role shifts with the emphasis now on nursing treatment to heal the wound. In this phase the OT continues to work in prevention of future wounds, but also has a critical role in determining the cause of the wound. Unfortunately, it is often not until someone develops a wound, that the OT is called in whereas if they had been involved in the pre-wound phase this wound might have been prevented.

In the yellow "Post Wound" phase the emphasis shifts to empowerment of the individual to ensure that he does not develop another wound. The OT continues to maintain the prevention/monitoring role with the understanding that risk can change with age, with illness, with weight change, with progression of postural deformity or other life events.

Pressure management equipment can be prescribed in all phases of this model. It is important for the funder to understand that money spent in the prevention phase is absolutely worthwhile and will save money if a wound is prevented in a high risk individual.

Surface Selection
'Support Surfaces' refers to any and all surfaces that the client will come in contact with. This commonly includes wheelchair cushions and mattresses but also includes toilets, commodes, bathing surfaces, vehicle seats, furniture of all kinds, alternate positioning equipment of all kinds. Every surface can be modified to reduce the risk of skin breakdown. When selecting a surface there are 3 general principles to keep in mind:

1. Pressure Redistribution

2. Force Isolation or Offloading

3. Alternating Pressure

Pressure Redistribution refers to the spreading of pressure over as much surface area as possible to reduce loading up of one area. Generally this is done through immersion in water, air or foam or through contouring to match body contour. This principle is most commonly used in prevention and includes from simple/inexpensive solutions such as an memory foam overlay to complex/expensive systems such as a water/gel mattress, or a powered low air loss mattress where the amount of immersion can be set. The classic air cushion uses this principle where less air/inflation equals greater immersion and so greater pressure redistribution until too little air causes 'bottoming out' at which point the benefit is lost. Custom molded systems allow for extensive pressure redistribution through exact matching of body contour. A 'foam in box' custom molded system would fall in this category.

Force Isolation or 'Offloading' is commonly used in orthotic devices including footwear for diabetics, pressure relief boots that offload the heels and custom molded commercial cushions.

Alternating Pressure surfaces shift pressure from one area of the body to the other through differential inflation of segments and including lateral rotation. Typically powered mattresses, there have been a few cushions that use this principle as well, but of course require a portable power source.

Pressure mapping is used in assessment, prescription and monitoring of seating equipment. It is a clinical tool used to collect objective data and as such forms part of a thorough assessment and clinical reasoning process. The data is only useful if correctly interpreted by the clinician. Key parameters for visual interpretation (an ongoing dynamic clinical process) include:

Peak pressure: Pressure map area of highest pressure(s) that is/are not artefact readings. There can be more than one peak pressure within a map.

Pressure gradient: The difference between the highest to the lowest pressure with the objective in pressure redistribution of getting the lowest gradient possible (gentle slope, no peaks and valleys). Whereas in pressure offloading a high gradient is acceptable.

Pressure distribution symmetry: Comparison of the left and right sides of the pressure map for overall symmetry with the goal being even weight distribution side to side.

Pressure distribution dispersion: Distribution front to back; ideally loading fully from buttocks to thighs.

Total contact area: Evaluation of the total number of sensors loaded (sensors that show on the pressure map): The goal being maximum number to get the largest surface area possible for pressure redistribution.

Visual interpretation of peak pressure, symmetry, dispersion, gradient and total contact area are all done within the context of the entire pressure mapping session. They are useful terms to describe the pressure mapping session, but do not in themselves define individual client need or the recommendations that will arise from the session.

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E5: The Clinician Scientist in the Seating and Mobility Clinic: A Foundation for Education, Research and Clinical Practice

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I, Tina Roesler, have an affiliation with a medical equipment manufacturer. I am currently in charge of International Business Development for Motion Composites. I am a full time employee. I have been employed with Motion Composites since October, 2015. I was previously the Director of International Sales and Education with TiLite until July 2015.

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Summary of course
The role of the clinician is constantly evolving and advancing. Clinicians are pulled in many directions and need to become more resourceful with their available options. Evidence based practice is required to stay updated in the clinical setting and challenges for program development are essential to keep up with demands in the work environment. There are multiple ways to stay current and expand your role into a Clinician Scientist. These include participating in journal clubs and grand rounds, getting involved in clinical capstone design programs, clinical residencies/ fellowships and partnering with engineering programs. Collaborating with scientists for research is more within reach than you may imagine. This paper will outline explanations of each area of opportunity.

One simple way to keep up with literature is to start a journal club. Members of a journal club can occur with co-workers or clinicians of similar interests. Journal clubs can occur before or after work and can be a good place for networking and collaboration. A creative way to network can even be to meet before work at a local coffee shop which creates a fun environment and reduces stress from a potential stressful work setting. Another suggestion for a method to carry our journal clubs is to create an online community and use WebEx and other online resources to connect with colleagues out of state/country.

Grand Rounds is another example of networking and collaboration. Grand Rounds are more formal than Journal Clubs and usually have a central speaker who is an expert on a topic. This speaker takes the lead and facilitates discussion with the group for teaching and generating ideas.

Grand rounds are an important and common teaching tool and ritual of medical education. Most physician Grand Rounds consist of presenting the medical problems and treatment of a particular patient to an audience consisting of doctors, residents and medical students. Grand rounds help doctors and other healthcare professionals keep up to date in important evolving areas which may be outside of their core practice. Grand Rounds can be easily expanded to other professions and can link researchers and clinicians to come together for productive discussions. Grand Rounds can also occur onsite or remotely. There is usually a presentation with slides so is unlikely to occur at an information place like a coffee shop.

As clinicians have a more natural exposure to evidence based practice and begin to routinely participate in journal clubs and grand rounds, an evolving term has been introduced into the therapy realm. This term is what we will refer to as The Clinician Scientist. In Canada, Clinician Scientists have been traditionally referred to as medical doctors who have undertaken additional post-graduate training in health research or basic science (i.e. MD/PhD). However, other allied health specialists are now being added to the group. As both clinicians and researchers, these individuals play an essential and distinct role in the health care system. By virtue of their integrated activities, Clinician Scientists have an opportunity to undertake key aspects of the scientific research process (including, for example, formulating and testing hypotheses) within the clinical setting. In allied medical fields, the term Clinician Scientist has emerged because of the therapy programs in the U.S. are moving from bachelors to masters into clinical doctorate programs.

Given the development of clinical doctorate programs, newly minted occupational therapists and physical therapists are better trained to evaluate and apply research into clinical practice. They often have research and program development experience. The clinician scientist represents the application of education (professional development and precepting), research (collaboration with researchers), and clinical practice (evidence based practice and program development). This can create an opportunity to market the seating and mobility program, bring in other revenue lines, and improve your core skills as a clinician.

Given the trend toward terminal clinical degrees, specifically the OTD and DPT in the U.S., educational programs need placements for practicums. These practicums go beyond fieldwork, and are designed to allow the student an opportunity to develop a new clinical pathway, evaluate an existing or new program, develop a business plan, or perform research and development activities. These are a perfect opportunities for the clinician scientist to mentor a student, and more importantly address a need within the clinical setting.

Researchers are always looking for clinical partners, especially outside academic institutions, as it facilitates development of meaningful research questions, connections to the research population, conduction some of the research, and assistance with the knowledge translation piece so often needed to complete the research process. The three pillars of the clinical scientist, education, research and clinical practice, provide the framework clinicians need to advance professionally in today's market, furthermore, they provide seating and mobility clinics with high caliber clinicians that can make the program the best possible program.

Occupational Therapy and Physical Therapy in the U.S. also have developed Residencies and Fellowships. American Physical Therapy Association (APTA) has formal post professional Residency programs in designated areas of practice, these are for therapists who have completed their physical therapy degree and are interested in gaining more experience in an area of practice. An example of one product at the end of the Residency program would be the opportunity to obtain the Neurological Specialist Certification. Integrating the area of seating and mobility into residency curriculum is essential in preparing clinicians for aspects of patients' needs who use manual or power wheelchairs to get around. In addition to residency programs, APTA also has specialized

Fellowship Program. These often occur after the residency and have a more focused area of practice.

The American Occupational Therapy Association (AOTA) started Residency programs as well. These are new and still in the development phase. The AOTA Residency programs include mentored practice and didactic education in a focused area of practice. Another opportunity for therapy in seating and mobility is to collaborate with engineers. All engineering programs require a capstone senior design project. Programs are always looking for ideas and practical real life is as are appealing and meaningful for all participants. Matching needs and ideas of the seating and mobility community serve as excellent resources for engineering students.

These are all some examples and resources to utilize to carry out projects, ideas and programs. These are also some resources that you can use to expand and/or develop your skills as a Clinician Scientist.

Resources

APTA Residency Programs: http://www.abptrfe.org/ResidencyPrograms/About/

APTA Fellowships: http://www.abptrfe.org/FellowshipPrograms/About/Benefits/

AOTA Residency Programs:
    http://www.aota.org/Education-Careers/Advance-Career/Residency.aspx

Engineering Capstone Senior Design: https://mae.osu.edu/me-senior-capstone-sequence-options

Sample Program: http://sportsmedicine.osu.edu/research/

Grand rounds:
    Morrison, L.J., Portenoy, R., Giving a Grand Rounds Presentation. *Journal of Palliative Medicine.* Vol 13 (v 12), 1277- 1484. 2010.

Journal clubs:

    http://www.ptnow.org/blog/detail

    http://www.svnnet.org/wp-content/uploads/2015/09/Journal-Club-Outline.pdf

    http://www.itns.org/uploads/JournalClub_copy.pdf

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F1: From Paper to Practice: Clinical Application of Evidence-Based Practice in Seating and Mobility

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I, Marlene Adams, do not have an affiliation (financial or otherwise) with an equipment, medical device or communication organization.

There is a growing expectation from health care systems and funding sources that clinicians base their rationale on current evidence. This session will explore the benefits of integrating information from clinically relevant standards and practice guidelines when prescribing a mobility device. Therapists need to be knowledgeable of evidence-based resources in order to be cost effective, time efficient and have a positive clinical impact in the wheelchair service provision process.

The current resources are now easily accessible to therapists and equipment providers. They highlight best practices and assist in the justification and decision-making process. This presentation will outline how one seating clinic incorporated these resources resulting in improved outcomes, better confidence in equipment recommendations and enhanced understanding in this complex area of practice.

The following resources are consistent with each other and with the information often required by funding sources. All are available for free on the internet.

RESNA Position Papers
The Rehabilitation and Engineering Society of North America has excellent position papers based on evidence and the consensus of experts. These documents support practitioners in their decision making in a wide range of areas of seating including pediatric and adult seating, ultra- light weight wheelchairs, power positioning, and seating for positioning vs. restraint. They also have valuable position papers on Wheelchair Service Provision where they describe the roles and responsibilities for the therapist, vendor (sales reps and technicians), and the patient. This document can be shared with vendors to create a common conceptual and practical understanding. All these can be found in the RESNA Knowledge Center on their website.

www.resna.org

With these documents we found that it was best to skim the contents and then focus exclusively on the parts that were relevant to each patient.

International Standards
The guides to the international standards on terminology and seating measures identify what to assess and the terminology to use so that the assessment is meaningful and the terminology is consistent with vendor and manufacturer product descriptions. The two standards are:

1. A clinical application guide to standardized wheelchair seating measures of the body and seating support services (revised edition):
   https://www.ncart.us/uploads/userfiles/files/GuidetoSeatingMeasuresRevisedEdition.November2013.pdf

2. Glossary of Wheelchair Terms and Definitions:
   https://www.ncart.us/uploads/userfiles/files/glossary-of-wheelchair-terms.pdf

Working from these documents, and other guidelines, we now have an eight-page assessment form that allows us to collect the basic information needed to recommend equipment with confidence.

Guidelines for the prescription of a seated wheelchair or mobility scooter for people with traumatic brain injury or spinal cord injury
These guidelines, created in Australia, are a resource intended to help clinicians throughout the process of seating and mobility service delivery. They cover a range of topics including goal setting, assessment, client capacity and performance, training, transport and maintenance, upper limb ability and risk of injury, as well as propulsion and wheelchair features.

http://www.aci.health.nsw.gov.au/__data/assets/pdf_file/0003/167286/Guidelines-on-Wheelchair-Prescription.pdf

We have used this document to justify funding for devices such as power tilt, recline and elevating leg supports, power assist wheels, and a second mobility device.

WHO Guidelines on the Provision of Manual Wheelchairs in Less Resourced Settings
This document, intended for policy makers, outlines the eight essential steps in the provision of wheelchairs. The purpose of the document is "to assist WHO Member States to create and develop a local wheelchair provision system and thereby implement Articles 4, 20 and 26 of the Convention on the Rights of Persons with Disabilities."

http://www.who.int/disabilities/publications/technology/English%20Wheelchair%20Guidelines%20(EN%20for%20the%20web).pdf

The WHO guidelines will support requests for additional number of clinical visits and inform policy makers, managers and funders what is required in providing seating and mobility devices.

Wheelchair Skills Assessment and Training
Dalhousie University Wheelchair Skills Program has incorporated their research into their wheelchair skills assessment and training program, and have included assessment forms and videos on their website.

http://www.wheelchairskillsprogram.ca/eng/index.php

Having attended the Dalhousie wheelchair skills workshop we were inspired to incorporate the information into our O.T. and P.T. practice. With this resource we were able to advocate the need for wheelchair skills training and successfully applied for funding for new equipment and a dedicated space. This space is now used by individuals to practice new wheelchair skills when getting a new device. It is also a place to assess the ability to use the device safely on ramps, curbs and different terrains. Documenting this information is critical to support equipment recommendations.

Canadian Best Practice Guidelines for the Prevention and Management of Pressure Ulcers in People with Spinal Cord Injury: A Resource Handbook for Clinicians
This is one of the most current resources on the prevention of skin ulcers in the SCI population.

http://onf.org/system/attachments/168/original/Pressure_Ulcers_Best_Practice_Guideline_Final_web4.pdf

Pressure Management Assessment Tool
The cushion isn't the only surface that a wheelchair user sits on, yet it is often the first thing blamed for skin breakdown in this area. This tool was developed by an occupational therapist to explore the various factors known to contribute to skin breakdown. It gives the clinician a fuller picture of the potential variables acting on the client's skin.

http://www.hsc.mb.ca/files/sss-pressuremgmt.pdf

Spending more time with your client upfront to determine the true cause of skin breakdown saves time for everyone involved.

Concluding Remarks
These documents are also valuable to guide student learning in the classroom and on clinical placements.

Managing the large volume of information contained in these documents can be eased with the following strategies:

1. Keep a journal or learning log to record the things that did work exceptionally well.

2. Keep your resources close at hand. (e.g. above the desk or bookmarked in a web browser).

3. Reach out. (e.g. ask vendors, manufacturer reps, other clinicians for help and ideas).

Seating is complex, but you don't have to do it alone. Use the resources!

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F2: Spot-On,Hands-Free and On-Demand Manufacturing The Implications of 3D Printing for Seating, Positioning & Mobility Services

Richard Pasillas
Complex Seating Specialist
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Victor Carvente
3D Printing Specialist/Fabricator
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I, Richard Pasillas, am the owner of CUSHMAKER.com and the designer/creator of the 3D cushion exhibited and referred in the above syllabus and subsequent presentation. The material presented is a result of the research and applications of my theorems and practices. All client and product images presented in slide or video form are a depiction of my work and research as an independent/contracted seating specialist.

I, Victor Carvente, am an employee of CUSHMAKER.com and the co-designer/creator of the 3D printed objects manufactured, using FFF technology and referred to in the above syllabus and subsequent presentation. The material presented is a result of my research and the application of my skills at the behest of my employer. All client and product images presented in slide or video form are the property of CUSHMAKER.COM and a depiction of my work as a 3D printing specialist, while employed at CUSHMAKER.com.

If you view 3D printing as a suite of product design opportunities, then freedom of artist expression is the entry point of that suite and the ability to replicate on-demand is the finale. In between lies the ability to fabricate and detail a design to the specific needs or wants of every client you serve. In essence, you can literally print an idea into existence; with minimal labor requirements! Color, size, shape and embellishments are all on your menu of choices. Even totally unique and original designs become the seed for future iterations. It is this freedom to produce a single and unique product (as needed) that makes 3D printing so auspicious to the future of complex seating clinics, seating fabricators and complex rehab technology providers.

The broad arena of additive manufacturing (AM) includes a diverse class and hierarchy of 3D printing technologies: fused filament fabrication (FFF), stereolithography (SLA), selective laser sintering (SLS), UV light sintering, ink or alcohol curing, paste extruders, metal sintering, Ultrasonic Additive Manufacturing (UAM) and digital light processing (DLP), to name a few. New methods, mediums and materials are always in development; each to support different industries, performance requirements or budgets. For the purpose of this presentation, we will look at four specific types of printers, capable of producing indispensable (useful/relevant/practical) components and accessories for the seating, positioning, mobility industries and for the broader arena of complex rehab.

In many ways, you can also view 3D printing as much an art form or art medium as it is a freeform fabrication/manufacturing tool; where high-quality yet short-run production is necessary. To make an impact with this medium, you must be imaginative and willing to explore where there are very few guidelines for low volume manufacturing. You must also be willing to invest time and resources on a technology where change happens continually and where state-of-the-art is but for the moment. In fact, it is a medium that will likely remain in a state of flux for many years to come.

This flux status doesn't mean that you should shy away from the medium but rather embrace the opportunities it presents today and help advance it's place and purpose within our industry. If we examine closely, there are numerous opportunities for seating specialists to break new ground and ascertain new ways to use and implement the technology. In fact, it is already possible to 3D print an entire seating and positioning system; complete with hardware and data collecting electronics. The only component lacking in such an endeavor is the creative and focused effort of a sharp minded team to collate the existing elements into a functionally deliverable and cost effective package!

Investing in one type of printer does not necessarily mean you are stuck with one material or one printing method. Moderately priced, open-source FFF printers provide a platform to add on many aftermarket features and upgrades: multiple print heads, an array of printable filaments and even metal infused, conductive and stretchable/flexible materials. In fact, some open-source printers are so capable they allow for mixing disparate materials in a single print. The key is to first determine the material, performance and quality requirements of the finished product. Then, determine the best 3D printing technology. And finally, if you intend to print on your own, acquire a printer based on your specific budget and staffing resources.

Looking specifically at FFF printers, you can fabricate products made of nylon, ABS, polycarbonate, carbon fiber and hybrid composites. One of the biggest advantage of the technology is that no special molds, jigs or external platforms are required. If a design feature requires external braces in order to print, the printer will intelligently create those braces as part of the printing process. Consider that one of the most challenging features to print are unsupported bridges crossing open expanses. However, FFF printers, open-source software and cunning fabrication techniques have proven to tackle this task with considerable finesse. Another plus, for any size printer, is that with detailed planning, one can fabricate parts, components or full assemblies that are substantially larger than the printer's physical capacity. (Kayak)

From a strategic business perspective, one of the biggest advantages of using 3D printing technology is that it eliminates the need for various industrial tools: drill press, router, bandsaw, sander, vacuum system, etc. Not surprisingly, an array of hand tools become obsolete as well. Raw materials inventory, warehousing and waste disposal are also significantly reduced. Looking farther outward, even finished product inventory and technician workstations are greatly minimized. In other words, the old-school production and logistics mindset is turned on its head. Your operational footprint can literally be housed in the space of a traditional sized office cubicle. Such is the case in our 3D printing research department.

For many who are holding back, one of the biggest misconception is that one needs to own a printer to get involved. But that misconception is far from accurate. In fact, from a practical perspective, all that is required is a workable digital interpretation of what you want to print. Creating that digital interpretation allows you (or anyone else) to transmit the file to any printer in the world. Yes, even your neighborhood jobber or retail kiosk can process that file and print the item according to your instructions for material, color, size or density. Moreover, you can draw an object and someone else can verify its structural and print worthiness, refine the file, print it and deliver it to your designated end-user — all without you having touched or perused the actual delivered part. In other words, we are talking about the physio-digital distribution of clinical/technical expertise.

The second misconception is that, with a 3D printer, the goal is to replicate (by way of a cheaper process) a pre-existing product with predefined functionality. Wrong! Having access to the technology, the goal is to think outside current physical parameters, remove the traditional constraints of conventional manufacturing and bring forth a new interpretation of a proven solution or a new perspective for an innovative application. In one iteration you can transform the mundane into spectacular — largely by the flexibility obtained through 3D printing. Remember: no molds, fixture, jigs, industrial tools or elaborate workspaces required.

Open-source and rapid replication technologies have many intrinsically positive implications for our clients and our profession. If 3D printing technology does not appear on your top-ten career list of “must do’s”, then you may have to rethink those priorities. This technology is real, is here to stay and is very likely to impact every nook and cranny of our industry. The sole intention of the presenters is to enlighten and motivate attendees with gleaned technical information and firsthand experiences to encourage each to pursue a broader, more in-depth exploration of 3D printing technology. The presenters have thus far designed and 3D printed 40 distinctly different seating and positioning related products and have undertaken over 261 installments with 80 different clients. It is also believed that by the time their data is presented on March 1, 2016, they will have many more advancements to share with their audience.

This technology is real, is here to stay and is very likely to impact every nook and cranny of the complex seating/positioning/mobility industry. So maybe it’s just time for you to roll up your sleeves and get back to learning a new computer program such as Blender, Openscad, Design 123D, Sli3r or Cura. there is no doubt that as practitioners and fabricators gain comfort and experience with this powerful toolset the better off our industry becomes. Attending this workshop is your opportunity to begin that journey of discovery and action.

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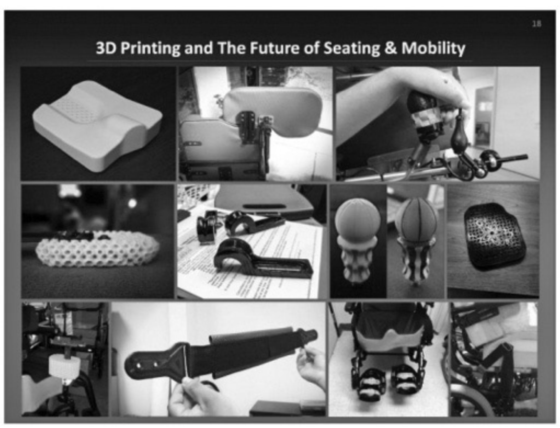

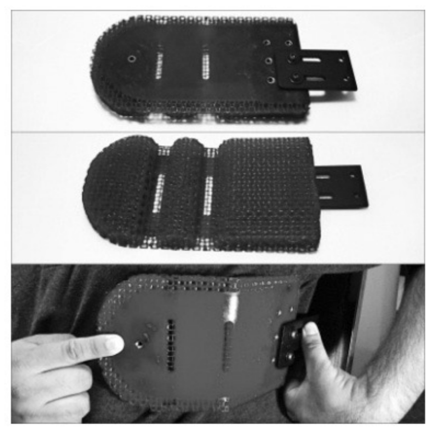

F3: The Other Seat! Where else is Skin Integrity preservation and postural management a critical consideration for individuals who use wheelchairs as a primary mode of mobility? In the bathroom of course!

Sharon Sutherland (Pratt), PT
Seating Solutions, LLC

I, Sharon Sutherland, PT am the owner of Seating Solutions, LLC. I do clinical consulting with Ottobock Mobility and Raz Designs.

A lot of time and resources are invested on skin integrity preservation and positioning strategies to help reduce the incidence of sitting acquired decubitus ulcers and postural deviations while sitting in manual and power wheelchairs. Regrettably, these individuals are still at significantly high risk of the same seating challenges if they are using improperly configured and poorly adjusted rehab shower commode chairs (RSCCs).

This presentation will review the clinical and functional needs of such individuals in conjunction with the seating and positioning attributes of rehab shower commode chairs.

Throughout this presentation the following will be the key areas of discussion:

- Important clinical considerations for individuals at risk for skin integrity issues - when these individuals are not in their wheelchair /seating mobility device - where are they and how is their skin being protected?
- How can best practice guidelines for skin integrity preservation be implemented when using Rehab Shower Commode Chairs (RSCCs)?
- When faced with prescribing or selecting a RSCC – what are the top 3- 5 clinical considerations?
- Interface pressure mapping – Can it be helpful in the selection of Rehab/Shower commode chairs?

Important clinical facts that should be considered during the selection and prescription of rehab shower commode chairs related to skin integrity preservation

- Anthropometrics – bony dimensions
- Postural presentation
  - » Anterior pelvic tilt – lordosis
  - » Posterior pelvis tilt – kyphosis
  - » Pelvic obliquity and rotation – scoliosis-wind sweeping

- Skin integrity presentation
  - » High risk
  - » Moderate risk
  - » Low risk
- Length of time in position for bowel bladder management regimes as well as for shower regimes
- Need for Independent function and/or Assistant control/he

How do we translate the clinical information collected during the hands on assessment into generic RSCC generic features?

1. Anthropometrics – bony dimensions
   a. Aperture:
      i. *Dimensions*
      ii. *Location*
   b. Access point location

2. Postural presentation: What are the clinical findings?
   a. Anterior pelvic tilt – lordosis
   b. Posterior pelvis tilt – kyphosis
   c. Pelvic obliquity and rotation – scoliosis-wind sweeping
      i. *Aperture and support surface shape*
      ii. *Seat adjustability/customization*
      iii. *Back support adjustability*
      iv. *Feet support adjustability*

3. Skin integrity presentation: Is the individual
   a. High risk
   b. Moderate risk or
   c. Low risk for skin integrity issues?
      i. *Support surface material/contact area*
         1. *Pressure distribution/shape and material*
         2. *Ease of transfers/shear reduction/yet enough friction for wet bodies*

4. Length of time in position for bowel bladder management regimes as well as for shower regimes
      i. *Weight shift ability... Independent or dependent (tilt for example)*
      ii. *Arm supports/location/weight load tolerances*
      iii. *Foot loading ability*
      iv. *Back support ability for optimally loading/set up*
      v. *Lateral and or anterior assisting supports*

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F4: Common Problems in Seating and Access to Integration and Use of Assistive Technology

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I want to disclose that I do have and have had some financial relationship with Adaptive Switch Labs, Inc., 125 Spur 191, Suite C, Spicewood, TX; 1-800-626-8698. They have sponsored or partially sponsored some workshops other agencies have requested on Seating and Access. I have also consulted for them with some specific patients/clients and/or their teams that have been geographically close to me regarding their ability to use alternative access equipment with their powered chairs. This is on an "as requested" basis, and I have never been asked to represent their products nor to "sell them" or "recommend them." I do regularly, (as exampled by this time at ISS) also teach and collaborate with Lisa Rotelli (ASL's executive director and coordinator of education) as we have become friends and colleagues. These collaborations have never had any renumeration.

The Seating Itself
Seating systems continue to be devised primarily with a focus on a skeleton with an anatomical perspective. This seating bias, does not allow a configuration to change or for the system to be managed adequately by the individual within the system. Seating Systems must take into account much more than they are currently doing.

AT is primarily needed by individuals with the most complex bodies, this includes children and children's seating canNOT look like adult seating. A single seat cannot possibly support the use of the body in independent movement. Seating systems based on anatomy are their to "hold" the body and "keep" the body in symmetrical alignment. However this is not how seating can work when a child must be able to use their body to manage an AAC device or accces to a computer, or learn to drive a powered chair. IN order to move an extremity the body cannot be "restrained." It must have freedom of movement and allow for weight bearing in both the pelvic and shoulder girdle. This means the extremites, themselves, must also be un-fettered. They need to be able to move and to be placed where the body wants them, not in a pre-determined "correct" position.

Also, seating for function should allow the individuals feet to be on the floor, not simply placed on a singular footplate. The pelvis must find gravity, weight bear and support the trunk to allow the head and upper extremities to move in order to manage any task, and computer access, AAC device use, and powered mobility all require the management of these extremities. To support independent controlled use of the head and arms, the pelvis must be active, and it needs to be able to weight shift, and rotate, and to do this the lower extremities must provide the support needed for that. This is best obtained by the feet being able to be on the floor and move or be placed where they can best support the pelvic mobility required.

Needless to say, seating systems provided today, do NOT allow for this. Especially in children, and with children. In fact, most seating systems do not take into account that the bodies seated within them are sensate, and must move to have power to manage themselves. This power is not generated internally but rather is a reaction of the body with gravity within the environment. Movement is how gravity “speaks” to the body, and how “power” or strength used, is able to manage intentional use of the extremties. And, how do we possibly plan for “movement” in a seating system that has been custom “molded” to support unique orthopedic changes in the skeleton. We must step back and recognize that we cannot use the simple simulation and surround techniques we have been using when developing seating. We must allow for movement. This requires more skill and knowledge of each individual seen, and it must include that the individual be able to be observed within engaging activity. This cannot be a “one shot” assessment.

Attention to task is also directly controlled by an active body. Not a relaxed body. The seating systems provided as a primary seating system, are created to “relax” the body, to support a body in staying still, and not moving. This lack of undrestanding that movement is necessary if wreaking havoc with control of access for use of AT within everyday lives, espcially with children, and with children who have complex bodies, which include hypertonicity, hypotonicity, and/or dystonnic reactions; and who are inexperienced in independent mobility, communication or activity.

We must recognize that we need to become much more knowledgeable about seating itself, and provide AT users with varied postures for them to work and to relax, to use their bodies as they can, and as they might, and how they would wish to. This will take equipment which is must more sensitive to “sensation” and the understanding of underlying physiological priniciples of movement, rather than the “physics” point of view currently purported.

Active relationships with gravity, may not be readily available within a single system, and several systems may be needed to learn use of the AT and development of the body. Integration of a system cannot occur without a body first having experience with varied activity, then these can be “put together” within a singular system and its compromises. This does not occur with children, until, they, too become adults, and experienced adults.

The Physical Configuration of the Chair and Systems

Very little time or effort has been invested in truly observing how individual bodies work, and how the physical configuration of a chair and system can impact an individual’s ability to work. We are finally looking at this within office spaces, yet, inaccurate knowledge about how a body works in activity is rampant here as well.

Most of the time, when using an AAC device, or needing access to a computer, simply the hardware for the management of these systems is put into place, that is the interfaces and cables. However, this is not simple to “add” to a standard frame of any chair. Chairs have not been developed to hold mounts, or to hold equipment, so all configurations are made to try and fit on the existence of a system that was developed without any thought to this.

It is extremely important that systems be mounted securely, and can be moved for transfers, and yet placed back into place where they are best used. However, this "best" placement may need to be altered in varied activity or in process of learning an activity, or with children as they have initial experiences and then become more experienced.

Joysticks and their size and mounts are ridiculously big. They also do not allow ease of view or placement for a particular person, and have limited range within the frame of any chair.

Where cables are "tied" or interfaces are placed, becomes really critical in pediatric systems since the "real estate" is by necessity much smaller, but the parts needed remain huge.

How can things be easily added, and then removed, and when removed where can they be carried? How can devices be mounted, yet altered while mounted to allow for differing use? How can multiple systems be used, an AAC device, computer, tablet, phone, and then access to attendant controls and driver controls? Right now, it requires patience, and compromise to try and configure systems. However, incorrect configuration can prevent independence, so this must be considered and supported when integrating system use.

The Programming

The biggest problem within systems is not usually the child's inability to learn the system, nor the adult's refusal to learn. Instead, it is a programming issue. Programming of the powered chair, programming of the AAC device, programming within the tablet, phone, and Ipad. Then, how does this programming also change when these items are integrated in their use?

When children are learning (and they are not yet readers and writiers) or an adult is using a system for the first time (and is unfamiliar with the system), we must program one way, and it must then change as experience dictates. Just making a system slower or faster is not what this is about. How an individual manages an on-screen keyboard, and its location, and its location to the menu bar, is as important, as to how the mouse works.

We have found that "mice" or the joystick working as a "mouse" is not just a plug and play item. How does the user manage click and double click? Where is an additional switch mounted, and of what type is it? Unfortunately, the developers of on-board "mice" were all able-bodied, were using a standard joystick and were readers and writiers. This is not true of our patients. They may be just learning these parts.

Mouse emulation, additional interfaces, may be required to manage the mouse "more" than the programming of the chair allows, or for more predictable and consistent use if "pairing" the blue-tooth technology becomes an issue.

How and where do we add control of the seat functions, the access to the AAC device, the phone, and a computer when we are using a 3 quadrant head control to drive? With children, the configuration should be set up for an adult to manage easily, as the child is learning the activity for which the configuration is the set up. In short, don't have a child worry about how to "Pair" a device or even move to the drive or profile which contains the AAC device initially. Set it up for the adult to do this. When the child then knows how to manage the devices, then integration for their access can be problem solved. Again, this will not a single plug and play. This is REALLY hard. As to the placement, the programming, and how it will work. It means that the person setting up the integration really needs to be fluent in the systems and how they work and how they work together.

Then, they need to alter this to suit the individual who will be using it. Most RTS and medical suppliers do not know their systems adequately for integration. This is because they do not do it every day. It is important that the therapists and teachers and parents who are with the child be in charge of this part. They need to know how the chair is programmed, have a programmer, and alter it themselves, for their own child or patient. This is the only way it can work. If a patient is an adult, I try and teach them to do this themselves, many are initially reluctant, but learn quickly that it really allows them to set things up for themselves. This, too, cannot be accomplished in a single session but happens over time.

Teaching How to Integrate Use of Systems, especially with Children; How the child will learn. All children (and adults) learn motor control and postural control through the development of routines. All learning has sensory motor components, and so far, we have paid far too much attention to the motor components, ignoring the sensory integration required to act, and repeat an act. All human beings, not just children, learn by process. This process becomes a routine which is an activity which can be anticipated. The anticipation is the ability to know what will be required to perform the activity, and the knowledge of the beginning, the middle, and the end of the activity. To develop routines, practice which is moderately novel must occur.

Increasing the frequency of the activity, rather than the duration, is how routines develop. Allow the activity to not be managed by an arbitrary longer length of time expecting endurance, but rather allow the activity to be repeated, ended, and eventually expanded.

React to the child's actions, rather than directing the child. If we directed all toddlers as they began to move, they would stop moving. Instead, we naturally support them emotionally. If they stop moving, we presume they intended to stop. So, also, must we support children who are developing experience with powered mobility. React to them, keep them safe, presume every action was intentional. When the chair and its programming and configuration are set up adequately, these actions of the child will be obvious, and under her control. Independence will be evident, although at first, fragile, in that it is not of a long duration, nor always able to be reproduced. However, if the child's actions are not obvious, and appear to be confused, or erratic or inconsistent, then, the chair is inadequately programmed, or the seating has been inadequately conceived.

This also includes integration of systems. Do NOT Integrate them initially. Obtain all the parts, interfaces, cables, and mounts needed, but do NOT start here. The child must learn to drive a powered chair first, must be able to use an AAC device first, must be able to manage a task within a computer and its on-screen keyboard, and a child must be able to use a phone. Then, we can start to put these together. We must teach how to do this.

We must teach mouse movement, and that happens by engaging in an activity within which a mouse is used. The child or individual can be given the "click" while the adult/teacher uses the mouse, and the activity is taught NOT the mouse. As the activity becomes clear as to how it works, then mouse control will be a part of the activity and can be used more. We constantly make the mistake of focusing on access first, and not the activity. All access improves with practice, but the practice is not with the access, the practice is within intentional activity. That is what we must do when teaching.

When will real success and real independence be achieved.

It is surprising how children with complex needs must meet expectations higher than ever expected of children with simple needs. Can any child's skills be predicted or anticipated? Can any adult's? No. Only an environment of support and curiosity can be provided to allow a child to demonstrate interest, and competence. Will every child who is in a powered chair be able to manage every unfamiliar environment efficiently? No, but then no child of any age, nor any adult of any age can manage every unfamiliar environment efficiently. However, all of us are able to demonstrate adequate and functional independent control as our personalities and experience and desire allow. Children with complex needs are no different. Some will learn quickly, and learn a lot, some will learn quickly, but only perform in some situations. All will demonstrate independent actions, and control in some environments. We can both tell you that, because it happens with the children we work with, every day, in all situations.

F5: Wheeling in the City: Mobility & Environmental Access Considerations across the Globe

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Rusk Rehabilitation – NYU Langone Medical Center

I Elaine Toskos do not have an affiliation (financial or otherwise) with an equipment, medical device or communications organization.

Overview
Urban users face a unique set of challenges when using their assistive technology. Whether it's a manual or power wheelchair, bathing equipment or sports and leisure device, accessibility, transportation and environmental issues seem to always compete.

This course will use case studies to review environments, equipment options available and outline various interventions used to provide creative and practical solutions to city dwellers. Equipment tolerance, design, form and function take on a whole new meaning when considering the architecture, living space and fast pace life of a major metropolis.

What is functional mobility?
What does it look like?
Who is the expert?

As an increasing amount of funding sources narrow down their scope of coverage, limiting mobility equipment to medical necessity only, over 3.3 million Americans are busy living with a disability not indoors but out in the world. Community based practice embraces participation and has empowered users needing mobility devices to push the definition of necessity and along with it the need to change policy.

For US policy makers and funding sources, the growing need for mobility technology is met with roadblocks and an increased burden to prove; why pay for it?

For clinicians a shift occurs from authority to facilitator, considering assistive technologies used in unconventional ways with a focus on independence and an active lifestyle.

Specific mobility examples and international accessibility comparisons demonstrate how these technologies are not convenience items and highlight:

Portability
Tolerance
Usability
Aesthetics
Attitude
Funding

Is living in the world a convenience?

Just as the International symbol for disability depicting a static figure, has now leaned forward with momentum to go places so should policy and coverage; Outside!

Measurable Learning Objectives

- Understand three key features of wheelchair design that must be considered when selecting a device for travel.
- Describe two characteristics to consider when selecting a portable ramp.
- List three features to consider when selecting a device for bathing access.
- Identify three funding sources covering assistive technology equipment used for community access.
- State three elements of health which are impacted by mobility equipment.
- Be aware of at least one case study demonstrating urban mobility solutions.

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A complete list of resources and references will be provided at the session.

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F6: Specialized Seating and Mobility: Meeting goals and managing expectations

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I Mary McDonagh, do not have an affiliation (financial or otherwise) with an equipment, medical device or communications organization.

Goal setting with clients presenting with complex needs attending specialised seating clinics can be challenging at times. Clients, carers and therapists often have different priorities and perspectives when it comes to seating systems (McDonald et al 2007).

Goal factors, parent factors and therapist factors can influence and add complexity to the goal setting process (Forsingdal et al 2013).

Goal Attainment Scaling (GAS) can be useful for measuring outcomes for seating clients with complex need. Practical approaches towards using GAS can be found in literature (Bovend'Eerdt et al. 2009; Scobbie et al. 2011; Turner-Stokes L. 2009).

- It is important for therapists to ensure clients are supported, engaged and involved when it comes to exploring priorities and establishing realistic goals.
- Setting time aside to really listen to our clients, and allowing them to voice their concerns and explore what is most important to them, can go a long way towards finding common ground, which can in turn facilitate the process of setting and meeting goals in specialised seating.
- Establishing a multidisciplinary care pathway for the more involved clients can assist in providing a more supportive, co-ordinated approach to our seating interventions, and improve communication between clients and therapists in the clinical setting.
- This should lead to improved client outcomes and improved levels of satisfaction with service provision.

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I'm Leaving on a Jet Plane. I Hope I'll See My Chair Again

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Beneficial Designs

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Most people that fly commercially take for granted how easy and common it is to travel for business and travel almost anywhere in the world. Getting on and off the aircraft can be tedious and the seating conditions for economy travel are not exactly spacious. However, for wheelchair users that are unable to walk the experience is anything but easy.

Most travelers use a carryon for their luggage to avoid luggage fees, avoid the risk of lost luggage, and save time upon arrival. Imagine having to wait until the last person leaves the aircraft, being strapped in an uncomfortable narrow boarding chair to be pushed to the jetway, only to see that your wheelchair is damaged or missing.

This paper will outline the process that occurs for non-ambulatory passengers that travel with their own personal manual or powered wheelchairs. The wheelchair storage process and some of the problems that occur on a regular basis will be explained. How problems are currently resolved and solutions that the industry is exploring will be reported as well.

Literature review of lost or damaged wheelchairs

One of the biggest fears of flying on a commercial airline for a person who is non-ambulatory is leaving the wheelchair on the jetway to be stowed under the aircraft (Office of Aviation Enforcement Proceedings, 2015). If something happens to the wheelchair, it can mean the end of the trip or an unplanned tangential adventure at the very least.

David Perry of Dominican University, interviewed over 50 people who had loss or damage to their wheelchairs. He reported that the fear of breakage causes many individuals to choose not to fly or to use less expensive wheelchairs than what they usually use (Perry, 2015). A video posted by USA Today demonstrates a manual wheelchair being thrown on a conveyor belt like a piece of luggage. The wheelchair falls out of the aircraft and the handler puts it back on the conveyor belt without checking for damage. Yoni Wrong, executive director of the Center for Independent Living, in Berkeley, California had the backrest and headrest broken off of her wheelchair. Wrong commented, "When you hand your keys over to a valet, you don't expect that they're going to crash your car and not take responsibility for it and that's what happens to us." (Pavini, 2013).

If damage occurs on the outgoing flight, it can be an end to the holiday experience altogether. If an appropriate loaner is not available, the person may not be able to continue the trip (Darcy, 2012). Sometimes a loaner wheelchair is provided which can never replace the customization provided by a user's personal wheelchair. Often a power wheelchair is replaced by a clunky manual wheelchair for the time the person is out of town (Darcy, 2012).

The Open Doors Organization (ODO) study found that damage to assistive devices ranked third in complaints for people with disabilities after the first complaint being lack of assistance and the second being seating accommodations (VanHorn, 2015). Reimbursement for damaged wheelchairs varies per country and per carrier. While Unites States carriers may pay for a new wheelchair, European carriers and others often limit reimbursement to $1600.00 (Darcy, 2012).

Global Repair Group (GRG) based in Chicago is an exclusive provider of handling assistive device claims for many airlines. The president of Global Repair Group reports that his company receives an average of 900 claims a month. The claims are:

25% Rollers and canes, 20% Manual wheelchairs, 10% Continuous positive airway pressure machines (CPAP), 10% Power wheelchairs, 20% Scooters, 15% High end power and manual wheelchairs (Bliwas, 2014).

The process of stowing a wheelchair under the aircraft

The Air Carrier Access Act provides language that if you are the first wheelchair passenger to arrive in time to pre-board an aircraft and you have a standard folding wheelchair that will fit in the closet, then the airline must make you their first priority for the storage of your wheelchair in that closet. Power wheelchairs, scooters, tilt-in space wheelchairs, and manual wheelchairs not stored in the cabin must be stowed in the baggage area in the lower part of the aircraft.

When an individual transfers to a boarding chair on the jetway, the wheelchair is taken by baggage handlers. Manual wheelchairs can be carried down the steps outside of the door at the end of the jetway. Heavier powered wheelchairs must be disengaged and are often pushed to the nearest elevator and then taken down to the tarmac level of the aircraft and are then pushed back to the aircraft.

Once the scooters or wheelchairs get to the tarmac, the same conveyer belt that is used to lift luggage up to the belly of the aircraft is used to carry the wheelchair up into the aircraft. This is where various airlines differ in how the wheelchair is placed on the conveyor belt. Some airlines have their baggage staff lift the wheelchair to the platform edge of the conveyor belt, other airlines use a ramp, and some use a mechanical lift. Manual wheelchairs are typically placed on their side on the belt. If the wheels are not locked, the wheelchair can spin around and come off of the belt and fall to the ground. The ground handlers are not allowed to ride up on the belt holding onto the wheelchair. Some airlines attempt to stabilize the wheelchair while it is moved on the conveyor belt.

Baggage handler lifting power wheelchair onto conveyor belt

(Photo Courtesy of Global Repair Group/ Open Doors training program Powerpoint).

Eric Lipp of Open Doors Organization designed a product that is positioned on the conveyor belt to hold the wheelchair from rotating or sliding backwards.

Device to block wheelchairs from tipping backward when placed on the conveyor belt
(Photos courtesy of Eric Lipp, Open Doors Organization).

The opening of the storage doors to the aircraft vary in height from 29-39 inches depending on the aircraft (Open Doors Organization, 2016). The low door opening means that most powered wheelchairs have to be placed on their side to go through the baggage door opening of the aircraft.

Despite being able to fold the back down, the chair was unable to go through the cargo door upright (Photo Courtesy Global Repair Group/ Open Doors Organization).

The airlines will attempt to disconnect the power from the battery of the wheelchair for the flight. Upon arrival someone else will be responsible for reconnecting the battery and assuring that the wheelchair or scooter is working upon arrival (Society for Accessible Travel and Hospitality, n.d.).

Results of online survey

A survey was created to obtain information form non-ambulatory wheelchair users as part of a grant from the Paralyzed Veterans of America's (PVA) Research Foundation entitled "Boarding Devices and Aircraft Seats: Increasing Safety, Support, and Comfort." The goal of the survey is to obtain information from non-ambulatory wheelchair users about their personal experiences using aircraft boarding chairs, making transfers, their comfort level sitting in aircraft seating, and damage that may have occurred to their personal wheelchairs. As of January 16, 2016, 577 people have participated in the online survey hosted by survey monkey at: www.surveymonkey.com/r/wheelchairuserairtravelsurvey

Of 347 respondents who were asked if they had experienced loss or damage to their personal wheelchair, 57% responded "yes." The parts that were damaged included foot, arm, and head supports; head switching arrays; caster and mainwheels; control input devices; motors; clothing guards; damage to the frame; scratched paint; or wheelchairs damaged beyond repair.

One wheelchair user replied that they saw their wheelchair being used by ground handlers to carry luggage and another stated that a passenger took the wheelchair to push someone to the baggage claim area. In this case it took over 30 minutes to find the wheelchair. One traveler stated that their personal wheelchair was lost and never found.

When asked to rate how the situation was handled by the airline when a wheelchair was damaged, 14% stated the airline went above and beyond, 22% were satisfied with the outcome, 39% said the outcome was adequate as the wheelchair was functional, 5% stated the resolution was costly but the issue was resolved, 31% stated that the issue was resolved but took a long time, 15% stated that some major issues were addressed, but there were still problems, and 18% stated there was never any resolution. Note that some respondents selected multiple responses, possibly referring to more than one incident.

What is being done to prevent loss or damage

Linda McGowan has traveled around the world to large cities as well as very rural and remote areas. She feels that everyone needs to take responsibility to help make the trip a positive experience from the individual traveling with a wheelchair to those in the travel industry and the wheelchair manufacturers. Preventative actions and responsible reactions when something does occur are paramount to a successful flight.

Wheelchair Instructions: Van Horn suggests to attach a laminated set of instructions for wheelchairs being stored in the under belly of the aircraft. Travelers using a manual wheelchair should ask to have their chair stowed in the cabin closet (Van Horn, 2013; Society for Accessible Travel, n.d.). Permobil has a handout available on their website that can be given to handlers, which discusses how to optimally stow the power wheelchair (Jernigan/Permobil, 2016). It is suggested that if the wheelchair back is going to be disassembled off of the power wheelchair to allow the back canes to fold forward, that the individual come to the airport early to assure there will be enough time. This should be done long before boarding time, which will most likely result in the person sitting in an airport wheelchair or barding chair. The individual should ask to oversee the disassembly.

Identification Tagging: Proper tagging of all pieces being stored is essential. Open Doors Organization developed a systematic tagging process that allows for easy identification of various pieces on the wheelchair (Perry, 2015).

Take a picture of the wheelchair before it goes into the cargo hold to have record of what it looked like.

Keep Wheelchair Accessories in the Cabin: It is suggested that foot, leg, arm, back, and head supports; cushions; and other pieces that can be removed from the wheelchair be placed in a bag and kept in the cabin of the aircraft. If the joystick can be removed, it should also be taken on board of the aircraft. The battery charger can also be brought into the cabin.

Protective Bags and Cases: Several manufacturers make protective bags and containers for manual and some powered wheelchairs. These include Airshells, Troy Technologies Travel Covers, Wheelchair Caddy, and Wheelchair Armor from Haseltine systems. Some individuals have made their own containers including full plywood boxes that are put together at the airport in an effort to protect the power chair. (Price, 2016) There are many shared products for protecting the wheelchair when traveling posted on websites such as Pinterest (Ruder, 2014; wheelchairtraveler.com).

Bring repair items and tools in case something does get damaged. Linda McGowan who authored the book, <u>Travelling the World with MS in a Wheelchair</u>, stated that one of her bags is half full before she even begins to pack her clothes. In it she has “tire tubes, allen keys, brake extensions, brake covers, Vaseline, WD 40—and on it goes.” (McGowan, 2014, p.43). In an interview, McGowan states that she also brings baby powder and a table knife to assist with flat tire replacement and a six-inch piece of a rubber tire in case of a puncture (McGowan, 2016).

Training: Global Repair Group and ODO offer wheelchair stowage training for ground handlers at airports throughout the world. The intention is to teach ground handlers some general information about disabilities, person first language, how to push power wheelchairs that are not in gear, how to lift manual and power wheelchairs and scooters without inuring themselves or the wheelchairs, how to place the equipment on the conveyor belt to prevent slipping off, and how to get it through the cargo door and stow it in the cargo hold (Open Doors Organization, 2016).

Summary

The goal of the PVA funded project is to gather data through the survey and through subject testing to implement improvements to air travel for non-ambulatory wheelchair users that travel on commercial airlines. Quantitative and qualitative data will be used to develop specifications for improving boarding chairs, to make recommendations regarding transfer technologies, to identify seating accessories that can be used to make airline seats comfortable when sitting on pressure relief cushions, and to identify solutions to prevent damage that occurs to manual and powered wheelchairs when stored in the baggage area of the aircraft.

As part of the PVA funded project, many issues related to powered wheelchairs have been identified which could be addressed by a standard for a class of products that could be approved for Air Transportability. This includes a list of labeling requirements that have been identified as being important for ground handlers. Labeling to indicate if the wheelchair has sealed batteries, the location of safe lifting points, the weight of the wheelchair, location of the motor disengagement levers, location of a power disconnect switch or connector, removable seating system, or folding back instructions. Testing would also need to be performed to verify the wheelchair can be handled while lying on its side. Beneficial Designs has also been working on a protective cover for the joystick that can be fastened around the joystick.

Beneficial Designs has also prototyped an elastic strap to hold cross-frame style manual wheelchairs in the folded position for storage on or beneath the aircraft. Having an elastic strap with a side release buckle can be used to hold a manual wheelchair closed in the folded position. This will reduce the likelihood of the wheelchair becoming unfolded and then damaged when a ground handler tries to fold the wheelchair by laying it on its side to squash it to fold it.

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Ethically Prescribed Technology

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Prompting Scenario

Joe is a client who has been seen many times over the years in your clinic for seating and mobility interventions. He has a chronic pressure ulcer over his right ischial tuberosity that continues to deteriorate despite optimal treatment. Joe is frustrated by the worsening wound, and wants the wound to close. You are at a loss as to what to do next as all of the potential causes for this deterioration have been addressed including, nutrition, local wound care, reducing pressure, friction and shear etc. Joe reports that he completes a weight shift every 20 minutes at a minimum. You have recently seen technology that will monitor the client's posture in the wheelchair, interface pressure, weight shifting and transfers. This device will send you alerts in real time when these indicators fall outside of parameters you as the clinician can set. You strongly believe that this information would help you determine the cause of the deterioration of the wound. Would you consider using this technology as part of your assessment? Would you consider using it over the longer term to help monitor changes and alert you to the need for a reassessment? What factors did you consider to reach this decision? What are the specific ethical considerations?

Introduction

As technology evolves, so do the ethical challenges faced by the clinicians responsible for prescribing these devices. Consider for example, the increased data collection and surveillance now available. Business Insider reports that 3.3 million fittness trackers were sold in the US between April 2013 and March 2014.[1] These devices enable users to track and monitor their fitness activies, and often their location, through web based applications. The ethical implications of this technology, as well as other technology advances has been recognized and discussed in various forums including magazines such as Scientific American, and in the media.

Technicological advances have also been made in Assistive Technology including being able to remotely montior clients, automate certain care activities and use technology to trigger assistance when a client falls. Although this technology may be beneficial and even welcomed by some, advances in technology also lead to ethical questions. It's important to take a step back an examine these ethical questions before we use this technology with our clients.

Ethical Concepts

Several ethical concepts, form the framework for this discussion including autonomy, fidelity, beneficence, nonmaleficence, and justice.

Autonomy means "the right to self determination and freedom from unnecessary constraints, interference or loss of privacy".[2] Underlying the concept of autonomy are the issues of informed consent and compentency. These are not new concepts to most clinicians, as informed consent and determining compentency have been discussed extensively in clincial literature. The new component is the clinician fully understanding the implications of using specific technology and being able to clearly communicate that to a client so that they can make an informed decision. Given that technology is rapidly changing, it is difficult for a clinician to fully understand the potential implications. For example, if a client monitoring system stores data on the “cloud”, who owns that information? If a therapist receives an “alert” for a client who has been discharged, what are their obligations in terms of follow up? Who is able to access the client’s data, and for how long?

Paternalisim is another issue underlying the concept of autonomy. Parternalism means assuming that safety is more important than freedom of choice and it is important to protect people from themselves. Although not a new concept, technology such as GPS enabled devices, offer a whole new dilemma to consider. What is the balance between client anonomy and privacy and monitoring the client for a fall to initiate a response from caregivers or emergency services?

Fidelity relates to faithfulness to the client in the context of conflicting opinions. For example there may be a difference between what the clician believes is “right” verses what the client wants, versus what the family or caregivers want, versus the opinion of other team members etc. Consider GPS enabled technology. What is the balance between a family member wanting to be able to find their loved one if they fall and need help, versus the right of that individual to privacy?

The concept of beneficence “requires that the intervention be provided with the intent of doing good for the patient involved”.[2] One issue underlying this concept is health care providers need to maintain their skills and remain current. Once again, the rapid change in technology makes staying up to date difficult for individual clinicians.

Nonmaleficence means not causing harm to others directly or through avoidance of actions that risk harming others. Clinicans need to consider the risk of harm to the client, and those around the client, from both using, and not using the technology.

Justice relates to the issue of fairness in individual, interprofessional, organizational and societal contexts. New developments in technology, may enable clients to participate in their world in new ways, however, the cost of the technology may be a barrier to access to this technology for some clients. Do clinicians have a role in advocacy to ensure an equitable distribution of new technologies?

Ethics in Assistive Technology Practice

There may not be a “right” answer for many of the ethical dilemmas related to advances in technology, but that doesn’t mean clincians should avoid new technologies. Clinicians do however, need to consider the ethical implications for each new technology and in relationship to each individual client and their situation.

Each time a clinician is introduced to new technology, it is important for them to consider the ethical implications in the domains of autonomy, fidelity, beneficence, nonmaleficence, and justice. Discussion of these concepts in relationship to assistive technologies within the community of assistive technology providers would also foster advancement in the ethical prescription of technology.

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Other Resources:

CAOT Position Statement: Assistive Technology and Occupational Therapy (2012)

http://www.atdementia.org.uk/editorial.asp?page_id=66 (information on Assistive technology for people with dementia)

1: Driving Controls for a Patient with ALS - A Clinical Case

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Abstract

Amyotrophic lateral sclerosis (ALS) is a progressive neuromuscular disorder that is characterized by loss of motor neurons in the cerebral cortex, brainstem, and spinal cord manifested by upper and lower motor neuro signs (1). The degeneration of the motor neurons causes a variety of symptoms including atrophy, spasticity, dysarthria, dysphagia, overwhelming fatigue, respiratory compromise, and progressive muscular weakness in muscles in the limbs, trunk, and bulbar muscles (2). As results of the muscular weakness, patients with ALS have physical impairments that affect their activities of daily living (ADL) performance. The progression of the disease is different for every person. This client lost his upper extremities functions first, and then he lost his lower extremities functions, but still had some residual movements in the lower extremities that could activate switches. The goal of this clinical case is to demonstrate how the team assessed and reassessed the client each time that his functional status changed. The team followed the client over a period of a year and modified the accessing method (activate the wheelchair and wheelchair seat functions) The team tried four different types of activation methods between joysticks and switches, so then the client could still perform his mobility independently and safely.

2: The Wheelchair Outcome Measure for Young People: On-Going Development and Clinical Usefulness

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Abstract
Independent mobility provides a foundation for overall development and participation in meaningful life situations, such as playing, learning, being part of a family, developing friendships and contributing to one's community. Wheeled mobility devices such as power and manual wheelchairs are often recommended to enhance children's independent mobility, when walking is difficult. Clinicians, children and families work collaboratively together to achieve individualized child and family-centred goals. Use of outcome measures help identify therapeutic goals, measure progress, and evaluate success of interventions.

The Wheelchair Outcome Measure for Young People (WhOM-YP) is one outcome measure developed specifically for children and youth under 19 years of age who use wheeled mobility devices. The WhOM-YP, modified from the adult Wheelchair Outcome Measure version, evaluates the importance of child (and family)-identified participation-related outcomes, and satisfaction with their performance before and after wheeled mobility-related interventions. Currently few participation measures are used in paediatric rehabilitation to evaluate wheeled mobility interventions (such as provision of new equipment, modification of current equipment, wheelchair skills training, education of support networks, and on-going skill and equipment monitoring).

The development of the WhOM-YP has evolved over several years: initially known as the Wheelchair Outcome Measure for Adolescents (WhOM-A), it has been revised to include younger children, as well as input from caregivers, depending on a child's age and abilities. Most recently, an online survey of 34 occupational therapists, and 47 physical therapists working with children and youth using wheeled mobility, as well as 47 OT and PT students provided feedback on its clinical usefulness, informing further development.

Purpose: To describe the WhOM-YP's development and clinical usefulness, and share clinical practice recommendations.

Clinical Significance: It is anticipated that the Wheelchair Outcome Measure for Young People will be a valuable addition to clinicians' measurement toolboxes when working with children and youth who use wheeled mobility.

3: New Wheelchair Accessory Prevents a Hunched Forward Head Posture While Seated

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Abstract

Wheelchair users frequently sit in standard straight-backed wheelchairs with a hunched forward head posture (FHP). FHP is one of the most common posture disorders and is assumed to be associated with thoracic kyphosis. To prevent FHP, we developed a new wheelchair accessory consisting of a pair of metal attachments located under the armrest frame, a pelvic belt, and two thoracic belts. The pelvic belt is fitted to both left and right attachments, and the thoracic belts are fitted diagonally to the left or right attachment and the opposite handle. We then investigated the effects of the accessory on the seated posture of elderly individuals.

Eighteen healthy elderly individuals (mean age, 76.1 ± 3.49 y; mean height, 162.5 ± 6.81 cm; mean weight, 61.2 ± 6.92 kg; males, n = 14, females, n = 4) sat on wheelchairs with the accessory (WAC) and without (NAC). We analyzed seated postures using the Dartfish movement analysis system and the pressure distribution on the buttocks and back using the Force Sensitive Application (FSA).

The posterior inclination of the trunk, head and neck was significantly increased on WAC compared with NAC. The maximal and average values and the sensing area of the buttocks were significantly lower, whereas the average value and the sensing area of the back were significantly higher on WAC rather than NAC.

The increased head and neck posterior inclination on WAC indicated that the accessory might prevent FHP. The increased trunk posterior inclination and pressure distribution on the back also indicated that the belts supported the trunk along the physiological curve of the spine, which might provide a stable base for appropriate head and neck alignment. Decreased pressure distributed over the buttocks on WAC might also help to improve skin problems.

4: Influence of Sacral Sitting in a Wheelchair on the Contact Pressure Distributions on the Buttocks and Back and Shear Force on the Ischial Area of Wheelchair Users

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Abstract
Aim
Sacral sitting is a seated posture with a pelvic posterior tilt and thoracic kyphosis, which is a typical poor posture observed in frail elderly adults using a wheelchair. It has been reported that sacral sitting with pelvic posterior tilt increases the risk of pressure ulcers of the buttocks. In this study, the pelvic inclination angle, contact pressures of the buttocks and back, and shear force were quantitatively measured while healthy subjects adopted sacral sitting in a wheelchair to investigate the influence of sacral sitting on the contact pressure and shear force loaded on the buttocks.

Methods
Twenty-six healthy adults assumed 2 postures: sitting up straight with the buttocks placed for back on the wheelchair seat as a basic seated posture, and sacral sitting with pelvic posterior tilt and the ischium sliding forward by 5 cm compared to the basic seated posture. In each posture, the

inclination angle of the sagittal pelvic line, maximum contact pressures and areas of the buttocks and back, and shear force sliding the Ischial area forward were measured.

Results

The posterior pelvic tilt was significantly greater on sacral sitting. The maximum contact pressure of the buttocks significantly decreased on sacral sitting, whereas that of the back, the contact area of the back, and the shear force sliding the Ischial region forward significantly increased.

Conclusions

On sacral sitting, the pelvic posterior tilt increased compared to that on basic sitting, the maximum contact pressure of the buttocks decreased, and the maximum contact pressure and contact area of the back, and the shear force sliding the Ischial region forward increased. Medical professionals involved in wheelchair seating should reduce the risk of pressure ulcers developing in the Ischial region of frail elderly adults by improving the situation regarding their sacral sitting.

5: Power Mobility Training For Young Children with Multiple, Severe Disabilities: A Case Series

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Background

Power mobility is increasingly used to ameliorate the impact of mobility limitations in children with neurodevelopmental conditions. Young children with multiple, severe disabilities, however, are often dismissed as too young or too physically involved for a power wheelchair and adapted ride-on-toys may not provide the external support necessary for these children. Our Play & Mobility Device (PMD) allows these children to practice power mobility skills. The purpose of this case series was to describe the outcomes of using the PMD with young children who have multiple, severe impairments. Case Description: The PMD is a small, highly maneuverable motorized platform that is designed for children weighing less than 40 pounds. The control system on the PMD interfaces with either a joystick or switches and can be adapted to meet the needs of each child. Three children with cerebral palsy ages 17 months to 3.5 years participated in the case series. Outcome measures included the Pediatric Evaluation of Disability Inventory – Computer Adaptive Test (PEDI-CAT), the Dimensions of Mastery Questionnaire (DMQ). An individualized, engaging environment designed to elicit specific beginning power mobility skills was created for each participant. Intervention was provided 60 minutes per week for 12 weeks.

Outcomes
Post-intervention PEDI-CAT scores increased in various domains for all participants. Post-intervention DMQ scores demonstrated improvements for 2 of the 3 participants. Participants 1 and 2 increased the number of independent switch activations between the initial and final training sessions from 42 to 147 and 0 to 93 respectively. By the end of training, Participant 3 was able to drive down long hallways and through doorways and maneuver around obstacles.

Discussion
The participants in this case series appeared to make improvements in their beginning power mobility skills. Additional research is planned to explore the impact of power mobility training in this unique population.

Learning Objectives
After viewing this poster and discussing it with the researchers, conference participants will be able to:

1. Discuss the outcomes achieved in this case series

2. Discuss the potential challenges of providing power mobility training for children who have multiple, severe disabilities

3. Explain the power mobility training methods utilized in this case series

6: Use of Electroencephalography to Objectively Assess Power Mobility Use in Children with Severe Disabilities: A Pilot Project

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Abstract

Background/Objectives: Despite recent research suggesting that children with multiple, severe disabilities may benefit from power mobility training, objective measurement of the changes observed in response to such training is hindered in this population by the motor or verbal responses required by existing assessment tools. We hypothesized that using power mobility may result in beneficial changes to a child's spectrum of electroencephalography (EEG) activity. Description: A pilot project was conducted with 3 children with cerebral palsy ages 2-7 years. A wireless, 14 channel EEG-system was used to record EEG signals for each child during the following 4 activities: sitting quietly in their own wheelchair, playing and interacting with adults (both with and without passive mobility) while sitting in their own wheelchair, and playing and interacting with adults while using a power mobility device. Due to difficulties with the fit of the wireless EEG headset, Participant 3 (who was microcephalic) was only recorded while sitting in her own wheelchair and when playing and interacting with an adult while using a power mobility device. A signal processing framework was developed to analyze the data.

Results: Each participant demonstrated changes in the spectrum of EEG activity; however, the greatest changes were observed between sitting quietly and using a power mobility device.

Significance: Given the dearth of research exploring changes in EEG activity in response to power mobility training, the findings observed in this project are encouraging. Further work is needed to achieve an appropriate fit of the wireless headset and to ensure consistency of electrode placement across subjects. Further research is indicated to investigate possible changes in the spectrum of EEG activity following a child’s participation in on-going power mobility training activities. Such findings may provide a means to objectively assess responses to power mobility training in children who have multiple, severe disabilities.

7: Off the Shelf and Out of the Box: Adaptation of commercially available product to meet custom needs

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Abstract

The purpose of this presentation is to present several wheelchair cases where commercially available product was adapted to serve alternative purposes to meet patient needs. These are areas where our program has had significant success and positive feedback from families, clinicians community and product manufacturers. Our hope is to present our work such that it can be available to the community to use and progress in development. The modification and adaptation of equipment to meet performance and functional need by practitioners we believe is important to achieving the best outcome for our patients. We have several wheelchair equipment cases as well as a brief explanation of methods to achieve these outcomes.

8: An External Support Device for a Liver and Kidney Prolapse

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Abstract
Introduction: JT was a 19 year-old male with a T6 AIS B paraplegia who was admitted to the rehabilitation centre for post-flap mobilization related to a chronic wound over the right ischial tuberosity. During the course of his mobilization the client reported his sitting tolerance was limited to 2 to 3 hours due to pain in his abdomen. He described the cause as a soft mass that slowly descended from under his right rib cage resulting in progressive discomfort and associated dizziness. Since the onset of the phenomenon three years earlier his ability to concentrate, to attend school and to go out with his friends was compromised. The agony was relieved by shoving a fist into his belly or by lying down. Previous diagnostics done in supine had not found any abnormalities. Through advocacy by his occupational therapist, an abdominal ultrasound was done in lying and sitting--in the upright position, “the palpable lump felt by the patient corresponded to the right lobe of liver and right kidney…”

The objective of the intervention was to design a support device to maintain the elevation of the liver and kidney thus mitigating the organ-related pain. The goal was to enable him to fully participate in daily living activities. Methodology: The initial approach was to use a soft support around his abdomen but, due to his lack of muscle tone, this acted like a tourniquet around his stomach. Therefore, a design for a rigid corset-like apparatus was developed. The poster identifies the functional considerations and presents the final product. Outcome: The support device stabilized the liver and kidney under the rib cage. With the pain relieved, the client was able to be upright in his chair for at least four hours at a time, paving the way for a more active lifestyle.

9: Development and Evaluation of an Ultralight Wheelchair with On-The-Fly Adjustability of Rear Seat Height, Backrest Angle, and A "Kneeling" Function

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Abstract

The Dynamic Wheeled Mobility framework includes "on-the-fly" adjustments for wheelchair users such that daily activities can be matched by an appropriate seat position. One such wheelchair, the Elevation™ wheelchair, has both seat height and backrest angle/recline adjustability available on-the-fly to users. These features provide many benefits for user participation and activities of daily living. Other dynamic features to enable participation may also be desirable. To explore further features and benefits, an Elevation-style wheelchair with "kneeling" functionality was developed. In particular, a front seat lowering mechanism was integrated into a novel wheelchair frame that also incorporated rear seat height and back angle adjustability. This new "kneeling" function aims to facilitate low-to-the-ground tasks such as floor transfers and other activities where sustained low level reaching may be required.

This paper describes the development of the kneeling wheelchair, as well as preliminary findings from end user evaluations aimed at validating the wheelchair's functionality and performance. The evaluations involved participants completing tasks that tested five key wheelchair features (i.e., adjustability/ portability, floor transfers, low position functionality, high position functionality, and perceived wheeling performance). Tasks were conducted using both the kneeling wheelchair and the participant's own wheelchair. Questionnaires were used to solicit participant opinions on each wheelchair. This wheelchair design aims to be an alternative to commercially available ultralight wheelchairs in terms of weight and performance, while at the same time providing a greater range of positioning than existing dynamic wheelchairs, which may support daily activities, health, improved quality of life, and greater participation.

10: Relationship between Pelvic Tilt Angles and Seat Pressure Distribution with Different Cushion Types

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Abstract

Objective: To investigate the trend of seat pressure distribution under the ischia and the sacrococcyx for various pelvic tilt angles with different cushion types

Subjects: Two healthy adult men (A and B)

Methods: A urethane cushion and an air pressure adjustable cushion were used. The subjects were asked to assume an upright sitting position on the cushions to determine the seat pressure distribution at various pelvic tilt angles (0°, 5°, 10°, 15°, 20°, 25°, and 30°). Measurements were performed using a tilt angle measuring device and a pressure distribution measuring device. For the pressure under the both ischia and the sacrococcyx, we used mean values obtained from the pressure distribution measuring device with the 2x2 sensors.

Results: With the urethane cushion, Subject A showed increases in the seat pressure under the sacrococcyx as the backward tilting angle of the pelvis increased, and the seat pressure under the sacrococcyx exceeded that under the ischia at a backward tilting angle of 25°. Subject B showed similar increases; with the seat pressure under the sacrococcyx exceeded that at the ischia at 20°. With the air pressure adjustable cushion, while the seat pressure under the sacrococcyx exceeded that under the ischia at a backward tilting angle of 25° in Subject B, it remained lower than the

pressure under the ischia in Subject A. Furthermore, the seat pressure tended to be lower in both subjects with the air pressure adjustable cushion.

Conclusions: There are differences in changes in seat pressure distribution between urethane and air pressure adjustable cushions, suggesting the need to take the cushion type into account when assessing seat pressure. Since this was a pilot study involving 2 subjects, we will collect and report data from approximately 15 subjects.

11: Garments for Friction Management for Wheelchair or Extended Bed Surface Users

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Abstract

There is growing body of evidence suggesting that friction causes shear stresses and strains in the tissue of wheelchair and prolonged bed users leading to increased risk of skin trauma - both at the surface and in deep tissues. There are currently very few interventions addressing friction and shear available for clinicians and users. An intervention must not only be effective at reducing/controlling friction (which causes shear stress/strain or abrasion), but must be practical and easy to use for clinicians and consumers. And, the consumer may find themselves in multiple situations and locations - in a bed, a wheelchair, or other in seating locations, such as vehicle seats, furniture, or recreational equipment. Transfers to and from each of these places cannot be expected to be performed perfectly 100% of the time - so also presents risks of skin damage. This presentation discusses how incorporating low friction interfaces directly into garments, such as underwear and socks, can provide skin protection wherever/whenever the consumer needs, without having to otherwise plan for or have independent devices constantly available. Multiple case examples will be presented to illustrate the various application possibilities and discuss experiences of the care givers and consumers.

12: Boarding Devices and Aircraft Seats — Increasing Safety, Support, and Comfort

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Abstract
There are several boarding devices used to assist individuals who are non-ambulatory to transport from the jetway to the aircraft seat. Three boarding chairs were evaluated with adults of varying ages and diagnoses. Measurements and documentations of the people and their wheelchairs were taken and compared to the three boarding devices and what was needed to assure safety and support. Individuals provided qualitative input as to perceptions of how it felt to be moved up ramps, over thresholds, and around sharp turns as well as comfort and posture. The transfer methods to and from the boarding chair and the wheelchair and the aircraft seat were also documented.

Aircrafts seats were also evaluated with individuals. A simulated aircraft with a row of three seats was used at Open Doors and RIC, as well as actual trips to the airport where airline terminals and aircrafts provided authentic opportunities for gathering evidence. Measurements of the size of the aircraft seat, how the transfer was done into the seat, and how the individual sat in the seat were documented. Components providing pressure relief, comfort, and support were used to determine if they made a difference in postural support and comfort. This presentation will demonstrate the research aims, evidence gathering, products and process changes tried, and any significance noted.

13: Global RePurposing: A Model for Meeting the Needs of the Underserved Internationally

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Abstract
In October 2014, a team of 2 ATPs and 2OTRs traveled to Kingston Jamaica to address wheelchair/seating needs for orphans in one residential program. All residents at the facility (N=450) have been orphaned or abandoned due to their disability status. The team was faced with many challenges including severity of disability that is unseen in the United States. Lack of physical and financial resources proved to be another obstacle for even the most simplistic of adaptations. The severity of disability also created a greater need for more individualized seating solutions. Due to the extensive needs of the organization, the team developed unique solutions to evaluate the residents for seating and mobility needs. These solutions, including the assessment of residents, collaboration with one graduate Occupational Therapy program/students, and innovative donation/collection process will be shared during this poster presentation. The resulting impact for learners will be a unique model to develop globally responsible citizens and meet the needs of under-served populations internationally.

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