YOU GOT TO MOVE IT, MOVE IT!
Pressure Reliefs, Weight Shifts, and Wheelchair Mobility in Individuals with SCI

Sharon Sonenblum, PhD & Stephen Sprigle, PhD, PT
July 13th, 2016
“I Like to Move It, Move It!”

I like to move it move it, Madagascar HD
All rights reserved to Dreamworks
Research Questions

• How do wheelchair users use their wheelchairs during every day life?
• How do wheelchair users move in their wheelchairs during everyday life?
  
  – New SCI vs. Longer-Term SCI

  – Recurrent pressure injuries (ulcers) versus no history of pressure injuries
Seat monitor and data logger

- 4 force-sensing resistors located under wheelchair cushion
- Data-logger captures forces at 1 Hz
Raw data is a continuous signal of forces that are run through a classifier.
Definitions

• **Out of Chair** – fully unloaded for > 2 minutes
• **Full Pressure Relief (PR)** – left and right sides fully unloaded for > 15 seconds and < 2 minutes
• **Weight Shift (WS)** – either side or both sides are partially unloaded (>30% pressure reduction) for > 15 seconds
Subject Characteristics

Recent SCI

- 31 manual wheelchair users
- 359 complete days of data
- Recruited through Shepherd Center and Kessler Foundation
- Characteristics
  - Ages 19-63 (Average 32 yo)
  - 25-215 days post injury (Average 97 days) at start of study
  - 22 men, 9 women
  - LOI split: 8 cervical, 10 upper thoracic, 13 lower thoracic or lumbar

Long-Term SCI

- 29 manual wheelchair users
- 225 complete days of data
- Recruited through Shepherd Center and Duke University / Durham VA
- Characteristics
  - Ages 21-66 (Average 41 yo)
  - 2-33 years post injury (Average 15 years)
  - 23 men, 6 women
  - LOI: mostly lower thoracic or lumbar (18), 7 upper thoracic and 3 cervical
  - 12 had a history of recurrent pressure ulcers
Time in Chair

Daily Time in Chair
95% CI for the Mean

<table>
<thead>
<tr>
<th>Time (hours)</th>
<th>Recent</th>
<th>Study</th>
<th>Long-Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Recent
Long-Term
Pressure Relief and Weight Shift Behavior

![Graphs showing frequency of pressure reliefs and weight shifts for recent and long-term periods.](image)
What is the timeline for change?

**Panel variable: SubjID**

**Frequency of Full PRs over Time**

- **Time Since Discharge (months)**
- **Frequency PR (per occ hr)**

The figure shows the frequency of Full PRs over time since discharge for different subjects, with time measured in months and frequency in occurrences per hour. The panels highlight specific time periods with a focus on the distribution of Full PRs.
What is the timeline for change?

Panel variable: SubjID
What is the timeline for change?

Frequency of Full PRs over Time

Panel variable: SubjID
What about Pressure Injuries?
What about Pressure Injuries?

Nobody does them regularly!
What about Pressure Injuries?

Weight shifting behavior IS different!
Wheelchair Propulsion

• **Bouts of Mobility** – A transition between stationary activities. Minimum speed of 0.12 m/s and duration of 5 seconds.
Manual Wheelchair Use

Daily Mobility
95% CI for the Mean

Num Bouts

Recent

Long Term

Study
Clinical Implications & Summary

- **Behavior changes with time**
  - After discharge, time in chair increases and propulsion increases, but protective behaviors decrease.
  - What does this mean about the AT prescribed to them while in inpatient? Does it still fit their needs?

- **Wheelchair users do not demonstrate routine**
  - All were trained in PRs and to target a frequency
  - We cannot assume dedicated PRs are routine

- **Weight shifts are much more common**
  - Intermediate forward and side leans qualify
  - In-seat movement can have an impact so
    - Education should address these activities
    - IPM as an education tool, especially because amount of pressure relief for a weight shift might differ by cushion
    - Position people so they can move

- **Activity is good**
  - put people in a position that they can do stuff
  - Seating systems and training to facilitate transfers
  - encourage activity-
    - leaning and reaching has positive tissue benefits
Acknowledgements

• Georgia Tech
  – Stephen Sprigle
  – Ricardo Lopez
  – Lizette Vonk
  – James Martin

• Kessler Foundation
  – Trevor Dyson-Hudson MD
  – William Weber

• Shepherd Center
  – Chris Maurer
  – David Kreutz
  – Marina Moldavskiy

• Duke / Durham VA
  – Kevin Caves
  – Helen Hoenig, MD

This work was supported by
National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR) as a part of the mobilityRERC
and
The Department of Defense (DOD) Spinal Cord Injury Research Program
QUESTIONS?