Wearables for Rehabilitation: What’s Available, How PTs Can Use Them, and How PTs Can Improve Them

Michele A. Lobo, PT, PhD

Disclosure

• No conflicts of interest to disclose.
About Me

• Associate Professor
  • Physical Therapy
  • Fashion & Apparel Studies
• Co-Director, Move to Learn Innovation Lab
• Founder, Director, Supersuits FUNctional Fashion & Wearable Technology Program

Outline

• Define wearables
• Types of wearables relevant for PT
• Design of wearables and why PTs should care about this
• Examples of wearables from my work
• Discuss how PTs can use wearables in practice – important lessons for implementation
Wearables

- Objects that interface and move with users

Types of Wearables Relevant for PT

- Inclusive clothing
- Supportive Wearables
- Smart Wearables
Design of Wearables

For “Real” Clients, Products Are Designed To Meet Their Broad Needs

Hall et al., 2018; Lobo et al., 2019
If Not, the Products Will Not Sell

Should Our “Captive” Rehab Clients Be Treated Differently?
This is Interesting, But Why Should I, as a PT, Care About Design?

- Current wearables, even those used for decades, poorly meet the broad needs of end users
- Impacts adherence, dosing, and our ability to improve the lives of our clients
Adherence for Using Lower Extremity Orthotic Devices

- Across 19 studies reporting on adherence for lower extremity orthotics:
  - 9-55% of users reported total lack of adherence
  - 6-36% of users reported partial adherence

Function of Lower Extremity Orthotic Devices: Mixed Positive & Negative Perceptions
How Can You, as a PT, Impact & Improve the Design of Wearables?

• Advocate for end users
• Share user needs with those commercially and medically fabricating and distributing wearables
  - Orthotists, prosthetists, industry
• Engage with designers within your community and across the global community
  - Academia - universities, schools
  - Organizations and maker groups
• Be informed and share connections with your clients
Inclusive clothing

Dressing is a Challenge for Individuals with Physical Disabilities
Simple Solutions = Big Difference

- Deeper armhole
- Wider neck for ease of donning/doffing
- Higher back rise for fit & comfort
- Magnetic closures for independent dressing
- Wider leg to fit over orthoses

Lobo et al., 2019

Resources for Inclusive Clothing

- IZ Adaptive Clothing: [https://izadaptive.com/](https://izadaptive.com/)
- Adaptive Clothing Showroom: [https://adaptiveclothingshowroom.com/](https://adaptiveclotingshowroom.com/)
- Adaptations by Adrian: [https://www.adaptationsbyadrian.com/default.asp](https://www.adaptationsbyadrian.com/default.asp)
- Professional Fit Clothing: [https://www.professionalfit.com/](https://www.professionalfit.com/)
- Myself Belts (belts easy to fasten): [https://www.myselfbelts.com/](https://www.myselfbelts.com/)
- Rebound Wear: [https://www.reboundwear.com/](https://www.reboundwear.com/)
- Easy Access Clothing: [https://easyaccessclothing.com/](https://easyaccessclothing.com/)
- Special Kids Company: [https://specialkids.company/](https://specialkids.company/)
- Hatch Backs Footwear: [https://www.hatchbacksfootwear.com/](https://www.hatchbacksfootwear.com/)
## Saliva Wicking Scarves

<table>
<thead>
<tr>
<th>Traditional Solutions</th>
<th>User-Centered Design Solutions</th>
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<tbody>
<tr>
<td>[Image of Traditional Solution]</td>
<td>[Image of User-Centered Design Solution]</td>
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Ren et al., in preparation

https://sites.udel.edu/move2learn/how-to-do-it/

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### Supportive Wearables
### Soft Ankle Support (SAS)

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<tr>
<th>Traditional Solution</th>
<th>User-Centered Design Solution</th>
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<tr>
<td><img src="image1" alt="Traditional Solution" /></td>
<td><img src="image2" alt="User-Centered Design Solution" /></td>
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- **Participant 1**: **Green Boot**
- **Participant 2**: **Pink and White Sandal**
- **Participant 3**: **Black Boot**

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### Barefoot
With an AFO

With the Soft Ankle Support (SAS)
What We Have Learned From the SAS Project

- SAS & AFO similarly supported function but the SAS was less bulky, lighter weight, more adjustable, easier to use, and comfortable
  - Less bulk means users can select a greater variety of shoes
- We should be innovating with soft materials to design more comfortable, aesthetically appealing, expressive, and accessible support devices for individuals with disabilities
- SAS DIY Manual is available at: https://sites.udel.edu/move2learn/how-todiy/

UD Magazine: Volume 23, 3, 2019 page 20

Move to Learn Innovation Lab | University of Delaware

Hug n’ Move Postural Support Garment

Move to Learn Innovation Lab | University of Delaware
## Smart Wearables

### Exoskeletal Garments

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<tr>
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<td>Playskin Lift™</td>
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<td>Playskin Air™</td>
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- Playskin Lift™
- Playskin Air™

Babik et al., 2016, 2019, in press; Li et al., 2019; Lobo et al., 2016, 2019; Lobo & Li, in press

[http://sites.udel.edu/move2learn/how-todiy/](http://sites.udel.edu/move2learn/how-todiy/)
Sensor-Based Wearables

Monitor → Feedback → Control

Lobo et al., 2019
What Should PTs Consider When Implementing Wearables?

• Device selection
  • User-centered based on broad needs
• Usability and adherence
  • How/what the device helps
  • How/what the device hinders
• Rehabilitation goals

Babik et al., 2016, 2019, in press; Li et al., 2019; Lobo et al., 2016, 2019; Lobo & Li, in press

Goal to Assist Performance

Lobo et al., 2017
Assistive Effects of the Playskin Lift™

Without the Playskin Inserts

With the Playskin Inserts

Increased bimanual contact, object lifting, manipulation, visual-manual activity, multimodal activity, intensity of activity, and behavioral variability.

Babik et al., 2019, in press

Goal to Improve Assisted and/or Independent Performance Across Time

Improved performance with the device

Device On

Device Off

Improved independent performance

Baseline  Intervention  Post-Intervention

Lobo et al., 2017
Rehabilitative Effects – Improved Independent Performance

Without the Playskin Inserts
Before Daily Home Intervention

Without the Playskin Inserts
After Daily Home Intervention

With intervention early enough in development, Playskin Lift™ may allow for improved arm function & greater independence from support devices.

Babik et al., 2019, in press

Important Lesson #1: A Tool, However Wonderful, Is Just a Tool

• Tools can complement activity-based interventions
• Technology use should be guided by scientific theory, clinical goals, & user’s abilities & needs
  • Impact and optimal usage may differ:
    • Among populations
    • Among individuals within the same population
    • Within an individual across time
Important Lesson #2: Don’t Give Up Before Trying

| Initial Independent Performance | After 2 Weeks with P-WREX |

Do Not Underestimate the Learning Potential of Users

Important Lesson #3: Let Users Have Time To Learn to Use Devices Before Determining Whether the Tools May Be Useful for Them

| With the Playskin Inserts Beginning of Intervention | With the Playskin Inserts 2 Weeks Later |
Important Lesson #4: Do Not Over Control

The initial impulse is to overcontrol but that might impede learning

Technology Resources

- Lobo Move to learn DIY: [http://sites.udel.edu/move2learn/how-todiy/](http://sites.udel.edu/move2learn/how-todiy/)
- Assistive Technology for Kids: [https://at4kids.com/](https://at4kids.com/)
- Assistive Technology Industry Association: [https://www.atia.org/home/at-resources/alliance-partners/](https://www.atia.org/home/at-resources/alliance-partners/)
- Association of Assistive Technology Act Programs: [https://www.ataporg.org/](https://www.ataporg.org/)
- Makers Making Change: [https://www.makersmakingchange.com/](https://www.makersmakingchange.com/)
- Assistive Technology Industry Association: [https://www.atia.org/home/at-resources/alliance-partners/](https://www.atia.org/home/at-resources/alliance-partners/)
- Association of Assistive Technology Act Programs: [https://www.ataporg.org/](https://www.ataporg.org/)
- Web interaction: [https://www.w3.org/WAI/people-use-web/tools-techniques/](https://www.w3.org/WAI/people-use-web/tools-techniques/)
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- Go Baby Go: [https://sites.udel.edu/gobabygo/](https://sites.udel.edu/gobabygo/)
- UD Maker Gym: [https://www.udel.edu/research-innovation/maker/spaces/makergym/](https://www.udel.edu/research-innovation/maker/spaces/makergym/)
- Able Gamers: [https://ablegamers.org/](https://ablegamers.org/)
- UD assistive technology library: [https://guides.lib.udel.edu/c.php?g=85328&p=548509](https://guides.lib.udel.edu/c.php?g=85328&p=548509)
- [https://library.udel.edu/erc/erc-services/assistive-technology/](https://library.udel.edu/erc/erc-services/assistive-technology/)
- Pinterest and Facebook can also be helpful for ideas and instructions
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References


References


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