FiRST and Foremost: A Look Into Our Future

Date: Saturday, October 1, 2016
Time: 11:05 AM - 12:20 PM
Session ID & Location: Ballroom I
CEU Eligibility: 0.125

Presented by: Dr. Steven Wolf, PT, PhD, FAHA, FAPTA

Session Description: This presentation highlights the history and formulation of the Frontiers in Rehabilitation Science and Technology (FiRST) Initiative from its origins as a steering committee for the 2009 Physical Therapy and Society Summit (PASS) APTA program to its establishment as a Council (February 2016). Embedded in this presentation are concepts which have been deemed important for the future of physical therapy practice and implications for how preparation for absorbing such knowledge should impact our formal education. Several examples of such interventions will be provided.

The intention here is not to offer an hour of lecture but to engage the audience with a proactive and constructive “give and take” as the Council moves forward to provide educational opportunities for APTA members. One offshoot from the initial efforts has been the creation of an “app” for stroke rehabilitation which will be demonstrated so that all participants can gain an appreciation for how the collective thought of many can produce products of value to the entire profession.

- To understand the origin of the FiRST initiative
- To define the present and emerging content areas for future consideration as areas in which the practice of physical therapy can be both influenced and make contributions
- To learn how available resources can be used by practicing therapists in an efficient and valued manner.

Presenter Bio(s): Dr. Steven Wolf, PT, PhD, FAHA, FAPTA explores novel interventions to improve extremity use in patients with stroke as well as mechanisms of cortical reorganization and inter-joint coordination associated with such changes. Within the past 23 years Dr. Wolf has led several NIH funded clinical trials governing this concept. More recently, his lab has been emphasizing clinical measures of neural plasticity for interventions designed to improve posture in older adults or stroke survivors as well as to improve limb function in the latter group through the addition of electrophysiological (including TMS) and imaging studies. Their newest studies involve use of robotics and mixed reality, both of which have telerehabilitation capabilities and are directed...
toward home-based treatment post-stroke. Their present NINDS ICARE RCT explores a novel intervention for upper extremity recovery in acute stroke survivors. Recently their stroke studies have also included obtaining buccal swaps to identify a polymorphism for brain derived nerve growth factor so that they can determine if a relationship exists between the presence of the polymorphism and limitations in reacquisition of motor function. They also study changes in upper extremity movement following stroke using home base robotic and telerehabilitation interfaces that complement their mixed reality studies. While their studies with stroke survivors have addressed primarily efforts to improve motoric function within the upper extremity, they have also done extensive work in monitoring lower extremity muscle activity to determine the extent to which selective feedback can enhance ambulation amongst stroke survivors.
1. The acronym FiRST means:
   a. Forever in Rehabilitation State Transitions
   b. Follow in Respectful Sequences Today
   c. Frontiers in Rehabilitation Science and Technology
   d. Frontiers in Rehabilitation Society and Transitions

2. First currently embraces all of the following concepts EXCEPT:
   a. Regenerative rehabilitation
   b. Health services
   c. Sensing technology
   d. Telerehabilitation

3. Acute Intermittent Hypoxia (AIH) is an approach that:
   a. Is designed to cut off all oxygen to the brain
   b. Serve as a neurostimulant
   c. Has been applied extensively to children with cerebral palsy
   d. Does not favorable improve movement function

4. Based upon available evidence, a critical time frame to determine a time beyond which reacquisition of hand movement following stroke is less likely to occur is:
   a. 1 month
   b. 2 months
   c. 3 months
   d. 4 months
FiRST and Foremost: A Look into our Future

Steven L. Wolf, Ph.D., PT, FAPTA, FAHA
Professor, Department of Rehabilitation Medicine
Professor of Geriatrics, Department of Medicine
Associate Professor, Department of Cell Biology
Emory University School of Medicine

Professor, Adult and Elder Health
Nell Hodgson Woodruff School of Nursing at Emory University

Senior Research Scientist, Atlanta VA Center for Visual and Neurocognitive Rehabilitation
“Changing” the way we see things

“Everyone thinks of changing the world, but no one thinks of changing himself (herself).”
— Leo Tolstoy

“Education is the most powerful weapon which you can use to change the world.”
— Nelson Mandela

CHANGE

• “You must welcome change as the rule but not as your ruler” (Denis Waitley, “The Psychology of Winning”)

• “Things do not change; we change” (Henry David Thoreau)

• “The bamboo that bends is stronger than the oak that resists” (Japanese Proverb)

• “Change is inevitable — except from a vending machine” (Robert C. Gallagher, photographer)

• “Time and Tide wait for no man” (St. Marher, 1225)
  • “Can you swim? (S. Wolf 2014)

Change can be Frightening
Or change can be embraced

I mean, really embraced!!!

**Historical Antecedents**

- June 2006, APTA HDD motion
- February 2009, PASS meeting in VA
- June 2009, report to HOD (passed unanimously)
- March 2011, Emory University organized and hosted a PASS-inspired event called Exploring the Future of Physical Therapy
- October 2011, ELM, Clearwater, FL. PASS implications
- June 2012, Emerging Technologies APTA Annual Tampa, FL
- Fall 2012, discuss interdisciplinary approach to PASS/technologies
- March 2013, birth of FiRST
- Summer 2014, over 20 presentations and publications

**PASS Recommendations: Advance in Development and Implementation of Technologies**

- Revisit the interface among practice, education, research AND technological advances
- Create mechanisms allowing all PTs to become familiar and stay contemporary with real and virtual technologies
- Promote the translation and integration of technology and science and foster collaborations with engineering, industry and others.
PASS Recommendations:

- Patient (consumer) centricity
- Eliminate “silos” between education, research and practice
- Advocate for leadership role in prevention, health and wellness
- Lead in establishing societal determinants of health
- Collaborate in developing and provide leadership in testing and applications of new technologies and approaches that optimize health care delivery

Contemplation & Queries:

- Do our educational programs prepare us adequately to absorb and use information relevant to an understanding and application of emerging sciences?
- Is our exposure in the classroom and clinic too limited?
- Is there a need to think “outside the box” and work with scientists, educators and clinicians who represent cutting edge discoveries in: molecular and cellular discoveries; behavioral therapies; technological advancement; electronic communications, etc.
- Are such individuals sensitive to our needs and if not, what responsibility do we have to make them so?
- AND MOST IMPORTANTLY.....how significant do YOU feel these queries might be in helping to shape our roles in health care and society?

Rehabilitation Time Lines: Informed and Directed

PRESENT
- Functionally relevant
- Emerging (and necessary) evidence
- Patient “Proactivity”
- Advancing technological interfaces and discoveries regarding plasticity of the central nervous system
- Continuous restrictions on reimbursable Rx time

NICHHD Scientific Vision
Diagnostic and Therapeutic Workshop
March 1-2, 2011

Rehabilitation Group:
- Definitions
- Basic science vision
- Novel consortia to advance translational research
- Need for new therapies
- Need for better measurement tools
- Value of biomarkers in rehabilitation (DTI, white fibers)
- Value of health informatics
- Need for new trial designs (Baysian or adaptive models)
- Advantages of computational models
- Education and training initiatives
Who Defines the Future?

- “We” do? (clinico-research centric)
- Consumers?
- External sources?
- Combination?

Caveat: are we prepared to listen and act?

Rehabilitation Time Lines: Informed and Directed

FUTURE

- Functionally relevant and changed Rx venue
- Required evidence
- Patient “Proactivity”......Care partner engagement
- Expected use of high technology/computer interface
- Continuous restrictions on reimbursable Rx time

Cutting Edge Concepts that Impact Neurorehabilitation

- Genomics
- Regenerative Rehabilitation
- Bioengineering (robotics, VR)
- Tele-health

Innovations in Technology

APTA Pod Casts:
- Genetics
- Robotics
- Telehealth
- Regenerative Medicine

APTA Website:
- Archived general information
- Resources on topics
- Case studies examples
- APTA positions/policies
- PTNow

APTA Website:
- Education
  - CEU opportunities (Fall 2012)
    - Robotics
    - Telehealth
    - Regenerative Medicine
    - Genetics

APTA Website:
- Internal and External Collaboration
  - Sections
    - Research
    - Health Policy and Administration
  - Education programs
  - Research community
Emerging technologies are vital to the future of neurologic rehabilitation: Frontiers in Rehabilitation Science and Technology

- Robotics
- Tele-Health
- Genomics
- Regenerative Rehabilitation

Genomics: Functional, Population, Rehabilitation

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Regenerative Medicine
Regenerative Rehabilitation

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Telehealth-video
Telerehabilitation

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Discovery: Pub Med Search

June 5, 2014   2/26/16

Telerehabilitation: 287
1998-2000..........005
2000-2009.........107
2010..................125 237

Telehealth = 20 categories

Home telehealth =2,848
1,185/2,848 (41.6%) 2010>

FiRST: External Reviewer Critical Content Areas

- Telehealth (Alan Lee)
- Bioengineering interfaces (START = Sensing Tools and Rehab (Technology)...(Deutsch, Trumbower)
- Genomic – rehabilitation interfaces (Kleim, Goldberg)
- Regenerative Rehabilitation (Ambrosio)

FiRST (Frontiers in Rehabilitation Science and Technology) ……The PROCESS

- Buy-in
- Assemble interdisciplinary groups
- Assign tasks
- Generate media
- Disseminate media
  - ELCs
  - NEXT 2014

FiRST (Frontiers in Rehabilitation Science and Technology)

- define informational bases that could be electronically accessible
- create avenues for relevant information dissemination that do not exist
- identify mechanisms to update and perpetuate this effort
- devise a plan that can/will be endorsed by educators and clinicians
- undertake these tasks in a cost-efficient manner
Robots in Rehabilitation

Generational and Interdisciplinary Issues (examples)

- father – son (caregiver) interactions
- Interdisciplinary course (Integrating Bioengineering and Physical Therapy…..Trumbower and Wolf)

Application of Telerehabilitation:
Home Arm Assistance Progression Initiative (HAAPI) Trial

Example

Regenerative Rehabilitation
Figure 1. Forearm volar performance in SCI rats. As shown in A, rats which received AIH treatment made less left dorsalis pedis compared to those which received sham treatment at 24. To select 1, 2 and 3, novice (HAYES et al., 2013) or sham (HAYES et al., 2013) or control animals were assessed for motor or coordination for the entire duration. Upper limb function (B) was assessed before surgery. After surgery, behavior and performance of each of the 4 days of treatment, both day 4 and 5, is shown for clarity, on the last day of treatment, and at 1, 3, 5, and 8 days following treatment. Panel A shows a guide to the structural separation of stages. Panel B: Full-time behavioral performance analysis at all 3 times. *p < 0.05, #p < 0.01. Significance was defined at the p < 0.05 level. (*)

A. Experimental Setup

B. Experimental Protocol Block 1: dAIH or dSHAM alone

Air Generator
Heart Rate/SpO2/Blood Pressure
Monitor

Ball A: “Marble” Diameter = 1.9 cm
Ball B: “Golf ball” Diameter = 5.2 cm
Ball C: “Baseball” Diameter = 7.6 cm
Ball D: “Softball” Diameter = 10.2 cm

EXTensor Carpi Ulnaris
EXTensor Digitorum
FLEXor Digitorum
FLEXor Carpi Ulnaris
Anterior Deltoid
Biceps
TRAcT Lateral Head

2.5 ms To Touch

Figure 1. Effects of dAIH on hand aperture (A), hand dexterity (B), arm speed (C), and grip strength (D) in persons with incomplete SCI. *p corresponds to significant difference from zero. Stacked significance defined at the p < 0.05 level.

Courtesy of Randy Trumbower, Ph.D., PT
More EXAMPLES
- Bioengineering → robotic device modifications → home health applications → telerehabilitation
- Arts and music → virtual environments → Wii home based interfaces
- Genetics → BDNF polymorphism → motor (relearning)
- Pharmacokinetics → cycloserine-D/ relearning
- Genetics → morphogenetic protein 2-induced changes in cancellous bone (osteoporosis and Fosamax)

Telerehabilitation Study

Generational and Interdisciplinary Issues (examples)
- father – son (caregiver) interactions
- Interdisciplinary course (Integrating Bioengineering and Physical Therapy.....Trumbower and Wolf)
Trumbower, RD, Johanson MA, Kapasi Z, Wolf SL: Interfacing engineering technology and rehabilitation: an interdisciplinary course for educating students in physical therapy, biomedical sciences, and engineering at Emory University. *J PT Education*, submitted for publication

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<td>Perspectives on regenerate medicine and plasticity</td>
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### Table 1. Class Topics and Sequence

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*Applied Physiology **Biomedical Engineering/Bioengineering

Trumbower, RD, Johanson MA, Kapasi Z, Wolf SL: Interfacing engineering technology and rehabilitation: an interdisciplinary course for educating students in physical therapy, biomedical sciences, and engineering at Emory University. *J PT Education*, submitted for publication
FiRST Council
Combined Sections Meeting, APTA
February 16, 2016

Example
A model for Telehealth/rehabilitation:
A post-stroke upper extremity app

www.neurorehabdirectory.com
• Select Product
• Body segment requiring information assistance
• Patients and family
• Pay it Forward
• Health Professionals – stay current
• Product costs
• Where do you need help
The challenge

• What are the barriers to implementing best evidence in your practice?
  – Time with patients/length of stay
  – Cost of equipment e.g. ES, robotics
  – Resources -staffing e.g. CIMT
• If you had access to this app when you return to your clinical practice next week – would you use it?
• We look forward to your feedback!

www.viatherapy.org

• 2,752 unique users, (>6/15)
• 4,359 use-time Sessions
• 35,500 page views
• 3:00 min average time spent
• 33% bounce rate (very low)

www.viatherapy.org

• Countries
  • 1500 USA
  • 972 users from Canada
  • 699 from Netherlands
  • 259 from Australia
• Operating system (Device):
  • iOS - 1800 users
  • Android - 538 users
  • BlackBerry - 22 users
  • Windows - 17 users

Additional Considerations

Cost estimates: $3.99/year
Insertion of videos and pictures
Updated literature
Data acquisition/ transmission
Lower extremity and beyond
Decision making process

• Why an algorithm?
  – Decision making process
  – Based on clear assessment criteria, chosen because of the prognostic indicators
  – Considered the evidence for interventions in the early rehab phase (up to 12 weeks), then after this when rehab may be provided in a less intense manner

Prognostic algorithm for the upper paretic limb

- Can the patient produce any voluntary muscle activity in the affected upper limb?
  - No:
    - FES
    - Hand Exten.
    - Shoulder Exten.
    - Finger Flex.
    - Finger Ext.
    - Forearm flexion
  - Yes:
    - Box 1: Contemporary Techniques

- With the forearm prone on a table and the hand and fingers unsupported: can the patient initiate finger (and/or thumb) extension three times within a minute?
  - No:
    - Box 2: Compensatory Techniques
      - Finger Ext.
      - Shoulder Exten.
  - Yes:
    - Box 3: Motor imagery
      - Box 3.1: videos
      - Box 3.2: Virtual Reality

At 12 weeks: Review goals and determine if a new approach is required

12 weeks

Early Rehabilitation

Late Rehabilitation

Chronic phase

Critical Features

- Global utility
- Levels of evidence
- Detailed assessment
- Valid and appropriate outcomes
- Filtering options (e.g., depression, aphasia, cognition, age dependent)
- Importance vs. Feasibility (Focus groups)
Evidence

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<td>B</td>
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Reference:


Take Home Messages

- Never be afraid to challenge in the spirit of acquiring knowledge
- What you know no one can take away from you
- Treasure and respect that acquisition and the means by which it came to you
- Have the conviction to believe you will leave this profession in a better place than when you entered it

Emerging trends in technology are vital to the future of rehabilitation, but are we ready?

1. We owe it to our students.
2. We owe it to our clients.

We have a responsibility to deliver safe and efficacious rehabilitation that is fully in tune with innovative medical treatments. (e.g., regenerative rehabilitation).

Once considered science fiction, re-growing body parts in a laboratory and then transplanting them back into a patient is now part of medical practice.
Twenty years from now you will be more disappointed by the things that you didn’t do than by the ones you did do. So throw off the bowlines. Sail away from the safe harbor. Catch the trade winds in your sails.

EXPLORE. DREAM. DISCOVER.

—Mark Twain—

Thank You
INSIGHTful Lecture:
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Presented by Dr. Steven L. Wolf, PT, PhD, FAPTA, FAHA

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