OVERVIEW OF STROKE REHABILITATION

Margaret A. Turk, MD
Professor, Physical Medicine & Rehabilitation, Pediatrics, Public Health and Preventive Medicine
SUNY Upstate
Disclosures

• No financial relationships with device or pharmaceutical company
• Past Research: PI on INSTRIDE Project, industry supported study
• CDC cooperative agreement funding: Disability and Health; Editor: Disability and Health Journal
• Off-label use of botulinum toxin injections for spasticity in lower limb (approved in upper limb)

Acknowledgement: patients/families, support of PM&R Department
Learning Objectives

• Discuss interplay between neural plasticity and rehabilitation.
• Review site options for rehabilitation following a stroke.
• Identify key aspects of rehabilitation.
• List promising new rehabilitation interventions to improve the function of people who have survived stroke.
REHABILITATION

... is a comprehensive process, that facilitates optimal status within the existing capacity allowed by the impairment, personal desires and life plans, and environmental disadvantages. Consumers/patients, families, and professionals work together as a team, identify realistic goals, develop strategies to achieve highest possible functional outcome.

(Turk & Mudrick, 2012)
ENABLING/DISABLING PROCESS

<table>
<thead>
<tr>
<th>PATHOLOGY</th>
<th>Stroke: injury brain</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMPAIRMENT</td>
<td>Paralysis: ↓motor control, weakness, hypertonia</td>
</tr>
<tr>
<td>FUNCTIONAL LIMITATION</td>
<td>Unable to walk or dress</td>
</tr>
<tr>
<td>SOCIAL PARTICIPATION</td>
<td>Unable to work, resume role in family</td>
</tr>
</tbody>
</table>

Disability = Interaction between Person and Environment

Changes (health and function) over time may be anticipated or modified. Critical factors in the physical, social, and psychological environments can affect transitions over the life course.
STROKE COURSE & REHABILITATION

• Typical history of recovery (in general)
  – Most rapid improvement months 1-3
  – Functional change slower after 3rd month, decreasing disability over 6 mos
  – Improvements > 1yr: environmental changes and practice
  – Participation in inpatient rehab: 60% vs. 39% independent walking at 3 mos  Preston et al, 2011

• Maintain function - ongoing exercise, focused home and OP program
## OUTCOME PREDICTORS

### Predictors Hand Fnc
- Flaccid UL at onset
- No measurable grasp 4 wks
- Severe proximal spasticity
- Prolonged flaccidity period
- >2wks no SFF/SAdd

### Increased Risk for Long-Term Disability

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Risk Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimal recovery 4 wks</td>
<td>Bilateral lesions</td>
</tr>
<tr>
<td>Low LOC</td>
<td>Previous stroke</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>Previous disability</td>
</tr>
<tr>
<td>Cardiac Disease</td>
<td>Poor sitting balance</td>
</tr>
<tr>
<td>EKG abnormalities</td>
<td>Global aphasia</td>
</tr>
<tr>
<td>Older age</td>
<td>Severe neglect</td>
</tr>
<tr>
<td>Delay in medical care</td>
<td>Sensory/visual deficits</td>
</tr>
<tr>
<td>Delay in rehabilitation</td>
<td>Impaired cognition</td>
</tr>
<tr>
<td></td>
<td>Incontinence &gt; 1-2 wks</td>
</tr>
</tbody>
</table>
PLASTICITY & REHABILITATION

• Injury and changes in brain circuitry:
  – Behavioral activity patterns
  – Alterations in environmental experience
  – Direct brain injury

• Common pathways interact to enhance or impede

• Activity – may facilitate rewiring, prevent maladaptive patterns

• Based on animal studies

Overman&Carmichael 2013
PROMOTING REHABILITATION

• Very Early: shorter, frequent mobilization associated with > odds favorable 3 mos outcomes, especially less impaired  
  Bernhardt J et al 2017

• ≤ 3 mos: ↑ dosing therapy results in better outcomes; varies based on clinical presentation  
  Lang CE et al 2014

• ≤ 3 mos: time-limited plasticity mediates spontaneous recovery, with augmentation by task-specific or exploration  
  Zeiler SR et al 2013
REHABILITATION CONTINUUM

• Benefits noted with rehabilitation interventions >6mos post stroke

<table>
<thead>
<tr>
<th>Categories</th>
<th>RCTs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor function</td>
<td>256</td>
</tr>
<tr>
<td>Cognition</td>
<td>39</td>
</tr>
<tr>
<td>Medical interventions</td>
<td>17</td>
</tr>
<tr>
<td>Psychology &amp; Community Integration</td>
<td>19</td>
</tr>
<tr>
<td>General outpatient therapy</td>
<td>8</td>
</tr>
</tbody>
</table>

• Unclear specifics of interventions related to method and dosing; repetitive practice most promising

  Teasell RW et al 2012
# Rehabilitation Settings

<table>
<thead>
<tr>
<th>Program</th>
<th>Site</th>
<th>Services</th>
<th>Med-Nsing</th>
<th>Therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Hospital</td>
<td>Neurology service</td>
<td>Mobilization; assess and determine post-acute needs</td>
<td>Primary acute services; PMR consultation</td>
<td>Daily as needed; goal oriented</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-Acute Care Continuum</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IRF/Acute</td>
<td>Separate unit/rules; Freestanding</td>
<td>Coordinated, interdisciplinary; serves high need, high acuity</td>
<td>Daily physician; 24hr nsing</td>
<td>3hrs/d, 6d/wk; require at least 2</td>
</tr>
<tr>
<td>SNF/Subacute</td>
<td>Unit within SNF; LTC rules</td>
<td>Multidisciplinary; at least 2 on-site services</td>
<td>Physician available; few staff on-site</td>
<td>1-2hrs/d, 5d/wk; require at least 1</td>
</tr>
<tr>
<td>Home health</td>
<td>In home</td>
<td>RN/Therapies</td>
<td>Nsing as needed</td>
<td>1-2hrs/d, 1-3d/wk</td>
</tr>
<tr>
<td>Outpatient</td>
<td>Facility based</td>
<td>Single service or multiple; ± coordinated</td>
<td>None</td>
<td>1-3hrs/d, 1-3d/wk</td>
</tr>
<tr>
<td>SNF LTC</td>
<td>SNF</td>
<td>Various</td>
<td>LTC regs</td>
<td>1-3d/wk</td>
</tr>
</tbody>
</table>
Guidelines for Adult Stroke Rehabilitation and Recovery
A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association

Endorsed by the American Academy of Physical Medicine and Rehabilitation and the American Society of Neurorehabilitation

The American Academy of Neurology affirms the value of this guideline as an educational tool for neurologists and the American Congress of Rehabilitation Medicine also affirms the educational value of these guidelines for its members

Carolee J. Weinstein, PhD, PT, Chair; Joel Stein, MD, Vice Chair; Ross Arena, PhD, PT, FAHA; Barbara Bates, MD, MBA; Leora R. Cherney, PhD; Steven C. Cramer, MD; Frank Deruyter, PhD; Janice J. Eng, PhD, BSc; Beth Fisher, PhD, PT; Richard L. Harvey, MD; Catherine E. Lang, PhD, PT; Marilyn MacKay-Lyons, BSc, MScPT, PhD; Kenneth J. Ottenbacher, PhD, OTR; Sue Pugh, MSN, RN, CNS-BC, CRRN, CNRN, FAHA; Mathew J. Reeves, PhD, DVM, FAHA; Lorie G. Richards, PhD, OTR/L; William Stiers, PhD, ABPP (RP); Richard D. Zorowitz, MD; on behalf of the American Heart Association Stroke Council, Council on Cardiovascular and Stroke Nursing, Council on Clinical Cardiology, and Council on Quality of Care and Outcomes Research

© 2016 American Heart Association, Inc.

Stroke is available at http://stroke.ahajournals.org

DOI: 10.1161/STR.0000000000000098
## ACUTE HOSPITAL REHABILITATION*

<table>
<thead>
<tr>
<th>Recommendations: Rehabilitation Interventions in the Inpatient Hospital Setting</th>
<th>Class</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is recommended that early rehabilitation for hospitalized stroke patients be provided in environments with organized, interprofessional stroke care.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>It is recommended that stroke survivors receive rehabilitation at an intensity commensurate with anticipated benefit and tolerance.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>High-dose, very early mobilization within 24 hours of stroke onset can reduce the odds of a favorable outcome at 3 months and is not recommended.</td>
<td>III</td>
<td>A</td>
</tr>
</tbody>
</table>

*AHA/ASA Guidelines for Adult Stroke Rehabilitation*
ACUTE HOSPITAL REHABILITATION

• AVERT Trial – 3 countries (not USA); difficult recruitment; early OOB
  – Caution re: BP stability, hemorrhagic component, level of impairment
  – Shorter, frequent OOB early improves outcome, control for age, severity and compare onset to first OOB (range 14.7 – 23.8 hrs); scheduling important
  – Therapy in bed also valuable

IRF Regulation

- Qualify for rehab services:
  - Acute: dx appropriate and stable; medical needs; will benefit; need at least 2 therapies; tolerate 3hrs/day; D/C plan to home; typical LOS 2-3 wks
  - SNF: at least 1 therapy need; will benefit; medically stable; can tolerate; D/C plan; typical LOS 2wks - mos

- 3 hours/day rule - proxy, based on consensus, old paradigm

- Required Pre-admission and Plan of Care/Admission paperwork – WU complete

- Insurance – policy defines post-acute care, industry guidelines, concurrent reviews, documentation; recent carrier interpretations

- Measurement tools required
# POST-ACUTE REHABILITATION*

<table>
<thead>
<tr>
<th>Recommendations: Organization of Poststroke Rehabilitation Care (Levels of Care)</th>
<th>Class</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is recommended that stroke patients who are candidates for postacute rehabilitation receive organized, coordinated, interprofessional care.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>It is recommended that stroke survivors who qualify for and have access to IRF care receive treatment in an IRF in preference to a SNF.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Organized community-based and coordinated interprofessional rehabilitation care is recommended in the outpatient or home-based settings.</td>
<td>I</td>
<td>C</td>
</tr>
</tbody>
</table>

*AHA/ASA Guidelines for Adult Stroke Rehabilitation
Acute Stroke Rehabilitation

- Shorter acute hospital LOS – shorter rehab admissions and higher FIM score, controlling for severity of co-morbidities
- Moderately and severely impaired – fewer days from onset sx and IRF admission, better FIM and outcome
- Moderately impaired – fewer days from onset sx and IRF admission, shorter rehab LOS

Maulden SA et al, Archives PM&R, 2005
REHABILITATION

• GOALS:
  Promote health and prevent additional disabilities
  Maximize mobility and self care
  Maximize communication and safety
  Reintegrate back to home, family, community
  Reestablish meaningful life

• REHABILITATION PLAN:
  Prevention secondary conditions and complications
  Focused therapy to improve limitations, impairments
  Functional training for compensation, use of devices
  Engage patient and family in education and training
  Resolution psychosocial and environmental barriers
  Function maintenance over a lifetime
MEDICAL REHABILITATION=IRF

- Comprehensive, goal directed, plan of care
  - Teams: physiatrist directed, inter- (or trans-) disciplinary; perspectives
  - Single service = therapy, not rehabilitation
- Formal communication - meetings, problem solving not reporting, barriers
- Regulation: Weekly, documentation, intensity/progress, outcome measures
- Family participation: meeting, education
IRF

• Prevent &/or manage medical conditions and complications:
  – Safety and fall prevention
  – Manage neurogenic bladder/bowel, DVT risk, co-morbidities, risk factors, associated conditions
  – Higher acuity
  – Spasticity and contractures
  – Pain syndromes (shoulder)
  – Emotional disorders
  – Education family/patient
  – Prevention recurrence or known secondary conditions
IRF PROGRAM

• Task-specific training (repeated, in context) + Enriched environment (↑physical activity, scheduled, interdisciplinary) = Better outcome

Takeuchi & Izumi 2013

Functional program (motor skills, self care, retraining, articulation or swallow, practice, challenges, compensatory skills, in context [Therapeutic Recreation])

Additions: Exercises; Modalities; System; DME; Cognitive; Counseling; Animal-assisted therapy; Education
• **Nontraditional noninvasive therapies:**
  - NMES/sEMG
  - Kinesiotape
  - Robotics, assist
  - Constraint induced movement therapy (CIMT)
  - Vision therapies
STROKE REHABILITATION

Effectiveness

• Repetitive task training improves U&LL fnc, remaining up to 6 mos  French et al, Cochrane 2016

• No treatment recommended over others for recovery postural control, LL function  Pollock et al, Cochrane, 2014

• Robotics-assisted gait training + PT associated with walking  Mehrholz et al, Cochrane 2010 & 2015

• Conditioning improves walking speed/tolerance, but not resistance training  Saunders et al, Cochrane 2016
IRF

• Return to community:
  - Home care
  - PCP, Specialty care
  - Environment adaptation
  - Recreation therapy
  - Equipment
  - Community activities
  - Vocational rehab plan
  - Education program for patient and family
REHABILITATION (Post IP)

• General integration
  – Safety and health promotion; physical activity, leisure, recreation
  – Return to school, work, driving
  – Education reinforced

• Goal focused therapy: traditional (outcome relates to amount of therapy time, unrelated to time from stroke)

• Non-traditional therapies: aquatics, pilates, robotics (virtual reality), walk-aide

• More aggressive tone management
STROKE REHABILITATION

Effectiveness

Longer Term Post Stroke

• While there are many studies, the details of method and dosing are not clear

• Moderate-low evidence for therapy-based self-care improvements  Legg et al, Cochrane 2003

• Insufficient evidence for community walking → independence  Barclay et al, Cochrane 2015

• Low evidence for cognitive remediation without reinforcement  Das Nair et al, Cochrane 2016
  Bowen et al, Cochrane 2013
Upstate Stroke Rehabilitation

- Inpatient/outpatient programs
- Traditional/nontraditional therapies
- Stroke Survivors Support Group
- Spasticity and tone management
  - Botulinum toxin, ITB
  - NMES, serial casting, taping
- WalkAide (INSTRIDE)
- Robotics: Lokomat, Armeo
- CIMT
- DME
- Pain management
Upstate Inpatient Rehabilitation

NeuroRehab ~65%
REHABILITATION
Outcomes Measurement

- UDS - National Registry
- Burden of care (social participation)
- LOS
- Efficiency
- Modified for CMS use (CARE Tool)
# REHABILITATION Outcome Measurement

<table>
<thead>
<tr>
<th>Description</th>
<th>2N IRF</th>
<th>Nation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cases stroke</td>
<td>149 (2016)</td>
<td></td>
</tr>
<tr>
<td>Age range stroke</td>
<td>12 to 95 years</td>
<td></td>
</tr>
<tr>
<td>LOS average</td>
<td>14.6</td>
<td>16.1</td>
</tr>
<tr>
<td>LOS efficiency</td>
<td>3.01</td>
<td>2.32</td>
</tr>
<tr>
<td>FIM gain</td>
<td>32.2</td>
<td>29.4</td>
</tr>
<tr>
<td>%D/C to home</td>
<td>73.8</td>
<td>73.6</td>
</tr>
</tbody>
</table>

**Onset to IRF Admission**
- Facility Actual Mean: 7.4
- Region Adjusted Mean: 11.4
- Nation Adjusted Mean: 10.2
STROKE REHABILITATION SUMMARY

• Stroke rehabilitation crosses a continuum.
• Early stroke rehabilitation is important.
• IRF is preferable to SNF for post-acute care, per AHA/ASA recommendation.
• Expertise is important for appropriate prescription and smooth progression of interventions.
STROKE REHABILITATION

SUMMARY

• Continued practice and exercise are important for long term functioning.
• Traditional and nontraditional therapies are available in the region.
• Reintegration to home and community are priorities, and requires family participation and education.