Rehabilitation Medicine Department: Research Highlights

Leighton Chan, MD, MPH

Chief, Rehabilitation Medicine Department
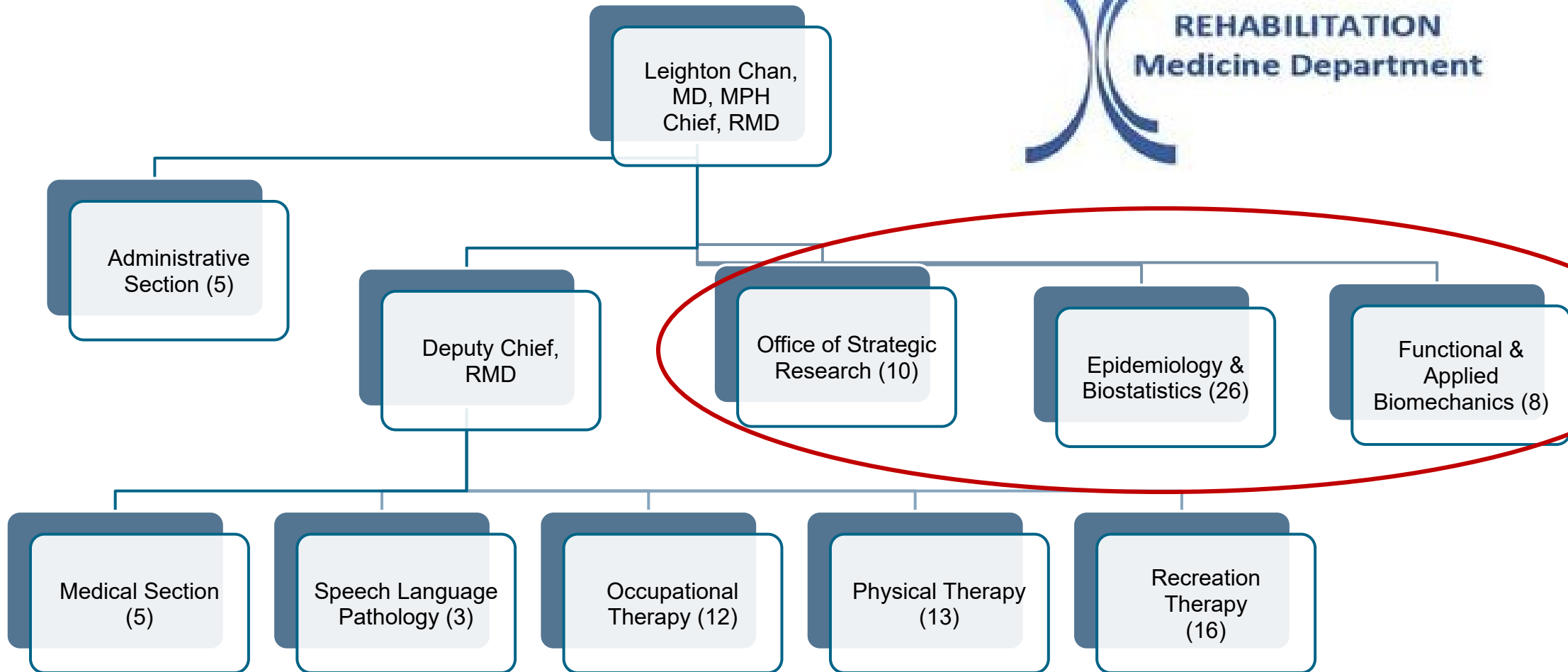
Agenda

- Department of Rehabilitation Medicine Organization
- Disability Assessment- Social Security Administration
- Exercise Science
- Diane Damiano- Biomechanics Laboratory

REHABILITATION
Medicine Department

Leighton Chan,
MD, MPH
Chief, RMD

Administrative
Section (5)

Deputy Chief,
RMD

Office of Strategic
Research (10)

Epidemiology &
Biostatistics (26)

Functional &
Applied
Biomechanics (8)

Medical Section
(5)

Speech Language
Pathology (3)

Occupational
Therapy (12)

Physical Therapy
(13)

Recreation
Therapy
(16)

# Research Section- Epidemiology and Biostatistics

- 3 NIH staff & 23 contractors
  - Clinicians, epidemiologists, programmers, health services researchers, mathematicians, statisticians, computer scientists, computer engineer
- Funded by the Social Security Administration
- Focus: Improve the Social Security Disability Process

SSA Disability Insurance Programs

- Serve over 15 million individuals
  - ~2-3 million new applications/year
- Benefits
  - $700-$1700 per month (75% of income)
  - Health Insurance
- Annual costs ~ $187 billion
- Process struggles with long wait times and many overturned decisions.
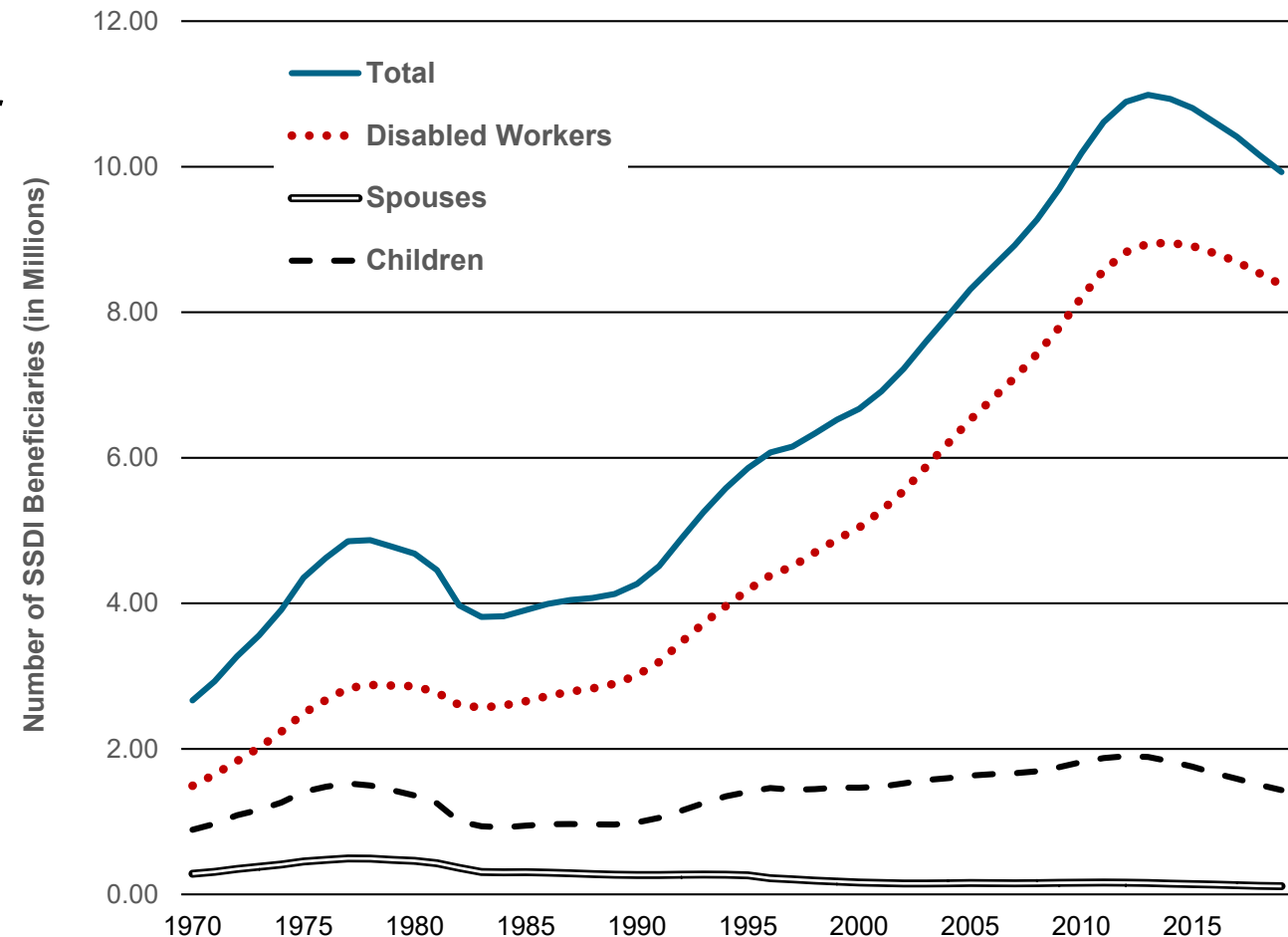
NIH-SSA Collaboration

- SSA-NIH/RMD Inter-Agency Agreement (IAA)
- Annual agreements beginning in February 2008
- Brought over $31 million to RMD to date: fund studies and infrastructure, hire contractors
- NIH Goal improve SSA decision making
  - Accuracy
  - Consistency
  - Timeliness

Problem #1

**□ Data Reduction**

- Adjudication by hand
- 8 minutes per case

Natural Language Processing Machine Learning

Extracting Function Information

Linguistic analysis

- Off-the-shelf software fails due to a lack of terminological coverage and ontology structure

- Vocabulary-based document classification is a valuable first step in prioritizing documents for review

- Keywords classify new documents with > 90% accuracy

- Our results demonstrate need to develop our own information extraction tools specific to function

Machine learning

Annotation: the gold standard
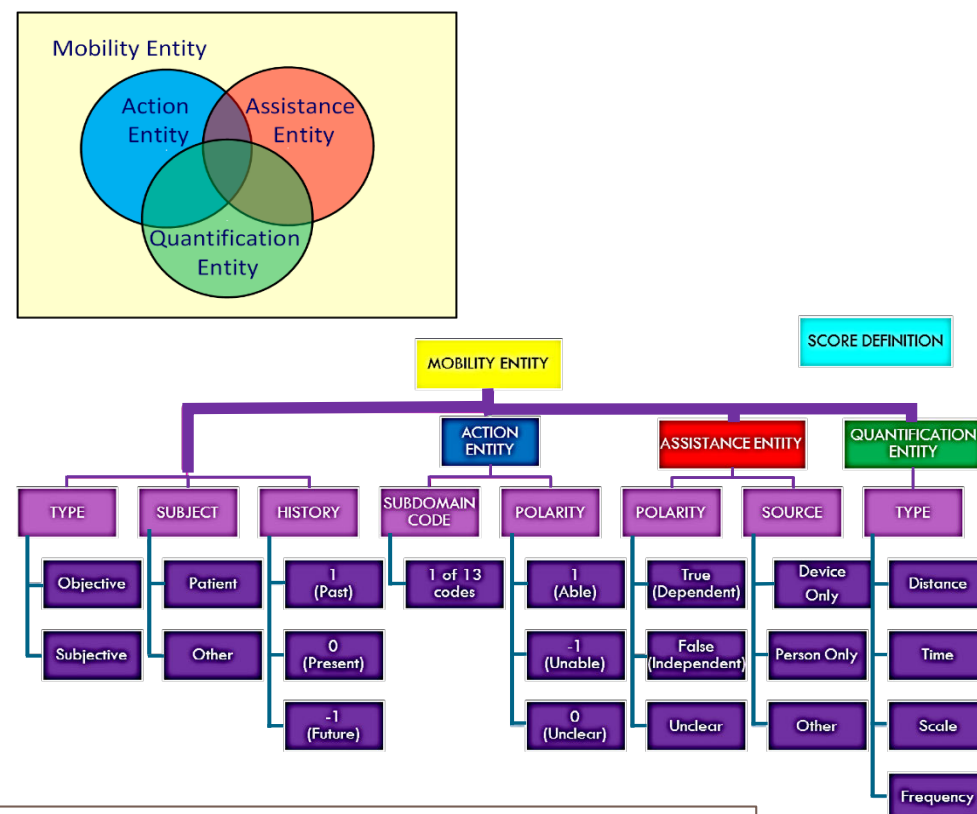
Using these annotations, we developed rule-based and machine-learned methods for function information extraction.

Problem #2

2) SSA spends a lot of time confirming a diagnosis

Novel disability assessment tool
Work Disability Functional
Assessment Battery (WD-FAB)

Transition from diagnosis to Function

- Diagnosis alone is a poor predictor of work disability

- Work disability the gap between an individual's <mark>functional abilities</mark> and their job demands
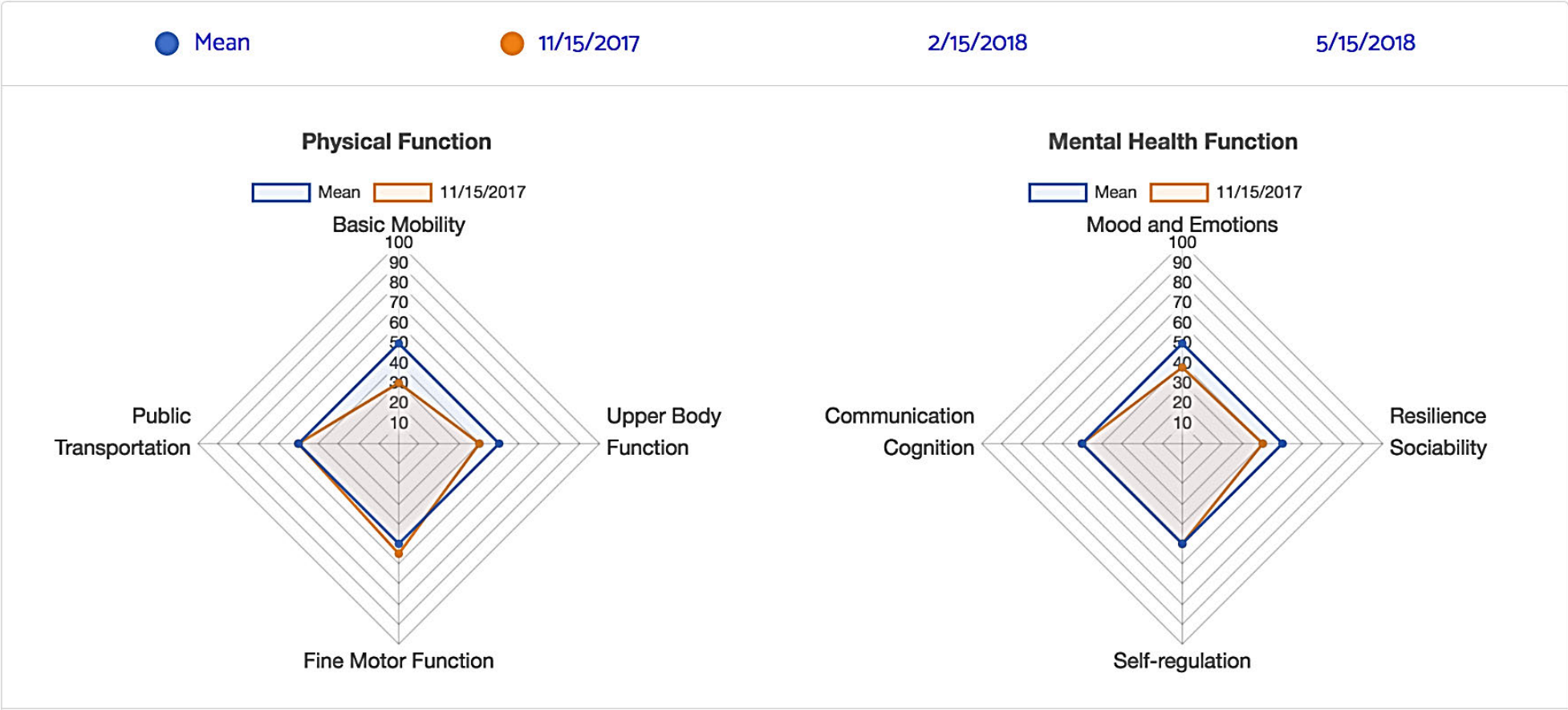
Functional Assessment: WD-FAB Profiles

Snapshot	Physical Function	Mental Health Function

WD-FAB Scores for John Doe

The display below compares the most recent assessment to the working age adult mean (50). To compare with previous assessment(s), click on the desired date(s).

● Mean   ● 11/15/2017   2/15/2018   5/15/2018

NIH impact on SSA

Data reduction

- NIH provided SSA with first set of NLP tools that will be working into their processing pipeline
- Given the enormity of the SSA disability programs even small changes in efficiency could lead to meaningful improvements and cost reductions.

Disability Assessment Tool

- WD-FAB has now been tested and validated. Starting to be used by SSA.
- Translated into German, French, Flemish. Uptake by social insurance programs in Europe may have more immediate impact.

Research Section- Office of Strategic Research

❑ 4 NIH Staff & 6 contractors

❑ Physiatry, Neuropsychology, Exercise Physiologists, Students/IRTAs

❑ Traumatic Brain Injury - supported by Department of Defense

❑ Havana Syndrome

❑ Exercise Science

Overview of Exercise Science Group
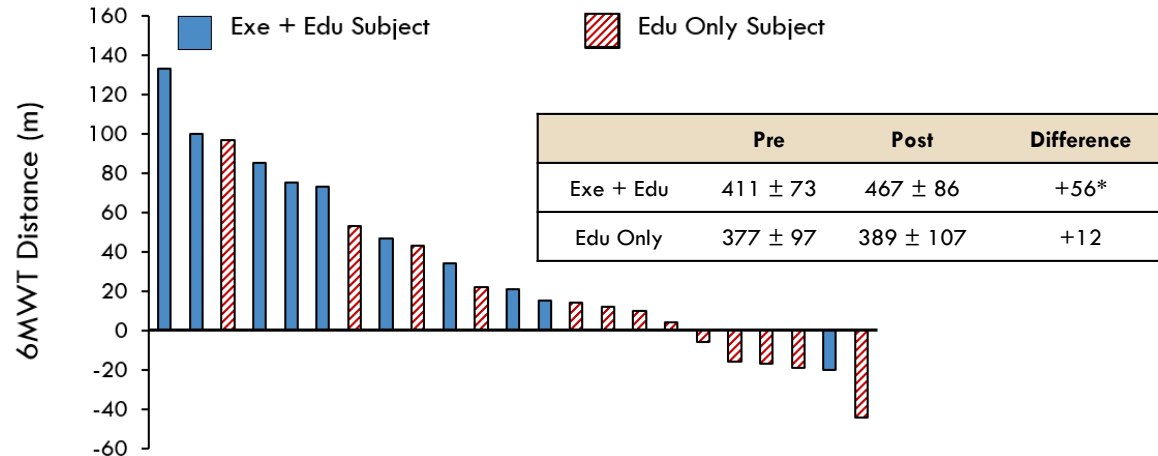
- We examine the effect of aggressive aerobic training on disease progression, functional capacity and QOL
- Focus on conditions with *few* treatment options and poor quality of life:
  - Pulmonary hypertension, SLE, IPF, and TBI
  - Utilize non-invasive systems to understand physiological responses/adaptation
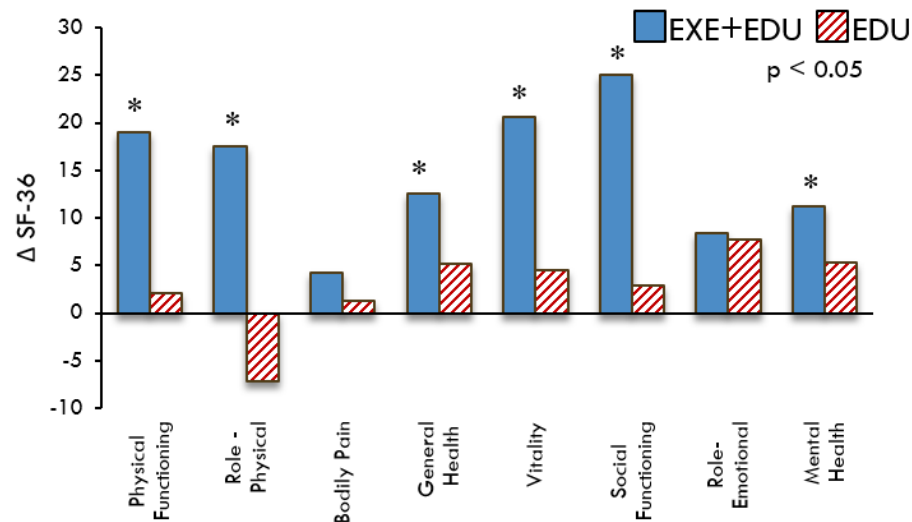
Principal Projects of Exercise Science Group

RCT Study Design
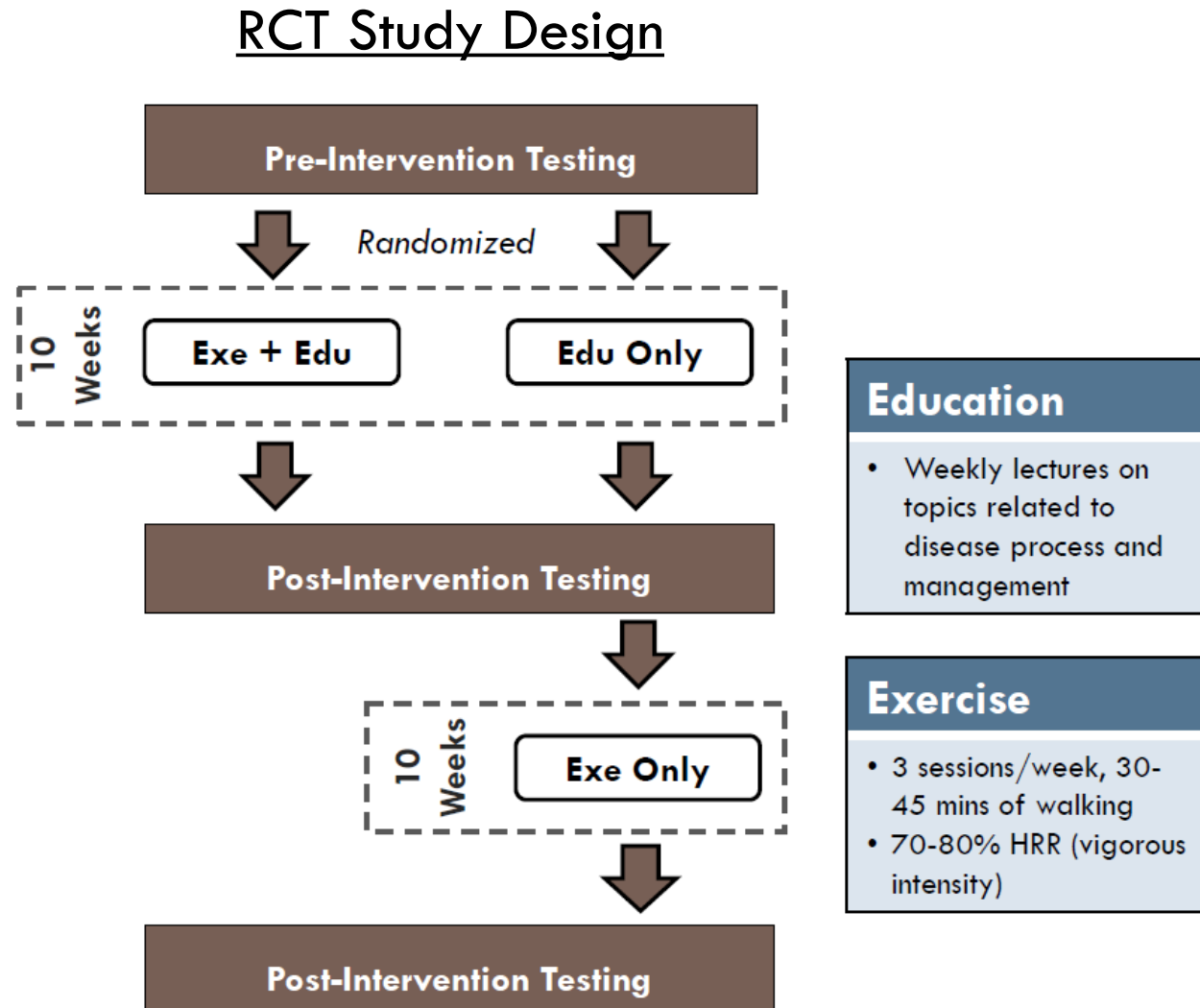
Early success in PH

	Pre	Post	Difference
Exe + Edu	411 ± 73	467 ± 86	+56*
Edu Only	377 ± 97	389 ± 107	+12

Primary pulmonary hypertension

Sean P Gaine, Lewis J Rubin   *Lancet* 1998; **352**: 719–25

Although there is no cure for PPH, there have been advances in both medical and surgical treatment. Physical activity should be limited, and medications that can aggravate pulmonary hypertension should be avoided—

Updated Treatment Algorithm of Pulmonary Arterial Hypertension

Nazzareno Galiè, MD,* Paul A. Corris, MD,† Adaani Frost, MD,‡ Reda E. Girgis,§
John Granton, MD,‖ Zhi Cheng Jing, MD,¶ Walter Klepetko, MD,# Michael D. McGoon, MD,**
Vallerie V. McLaughlin, MD,†† Ioana R. Preston, MD,‡‡ Lewis J. Rubin, MD,§§ Julio Sandoval, MD,‖‖‖
Werner Seeger, MD,¶¶ Anne Keogh, MD##

Bologna, Italy; Newcastle, England; Houston, Texas; Grand Rapids and Ann Arbor, Michigan;
Rochester, Minnesota; Toronto, Canada; Beijing, China; Vienna, Austria; Boston, Massachusetts;
La Jolla, California; Mexico City, Mexico; Giessen/Bad Nauheim, Germany; and Sydney, Australia

"…concordance of the results and the overall publication of 3 RCTs suggest the underlined upgrading of the recommendation for rehabilitation and exercise training to Class I with a Level of Evidence: A."

Chan et al, *Chest* (2013)

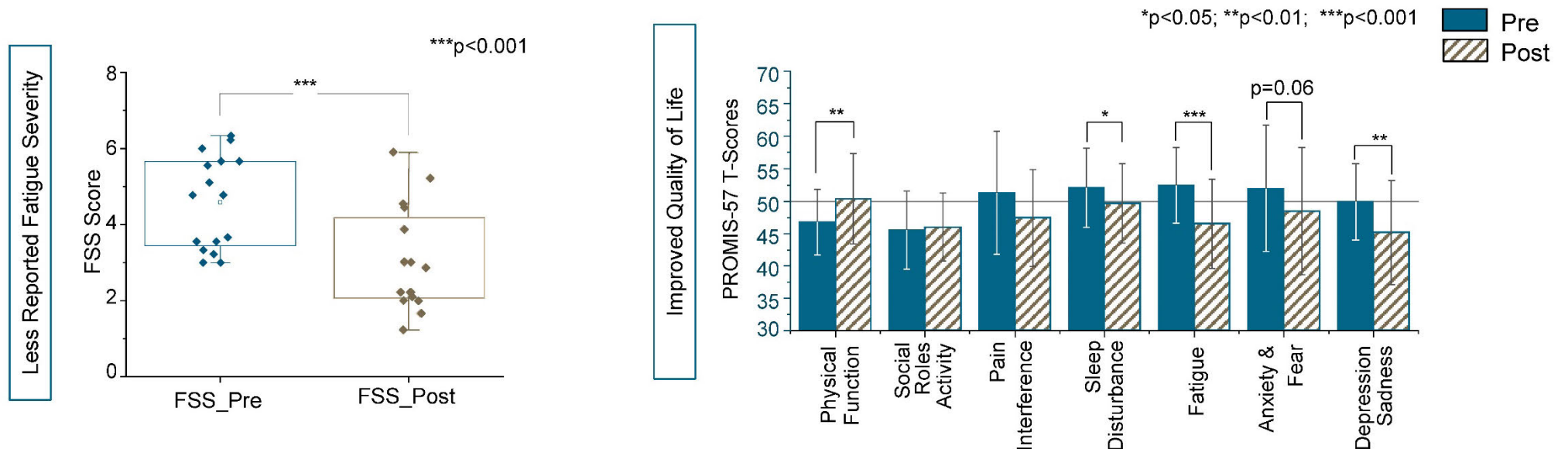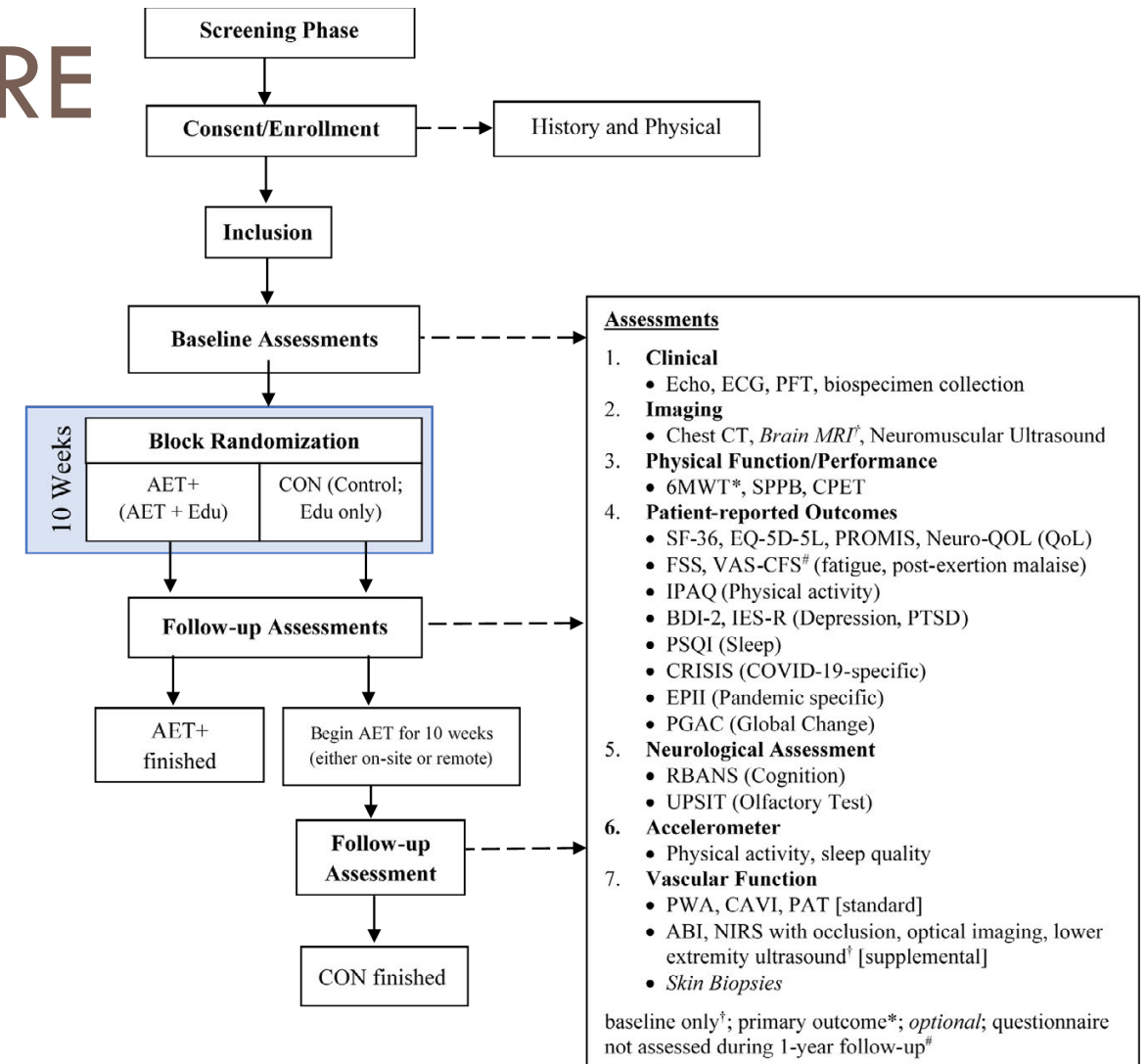# Exercise Studies at NIH: Results from Pilot in SLE
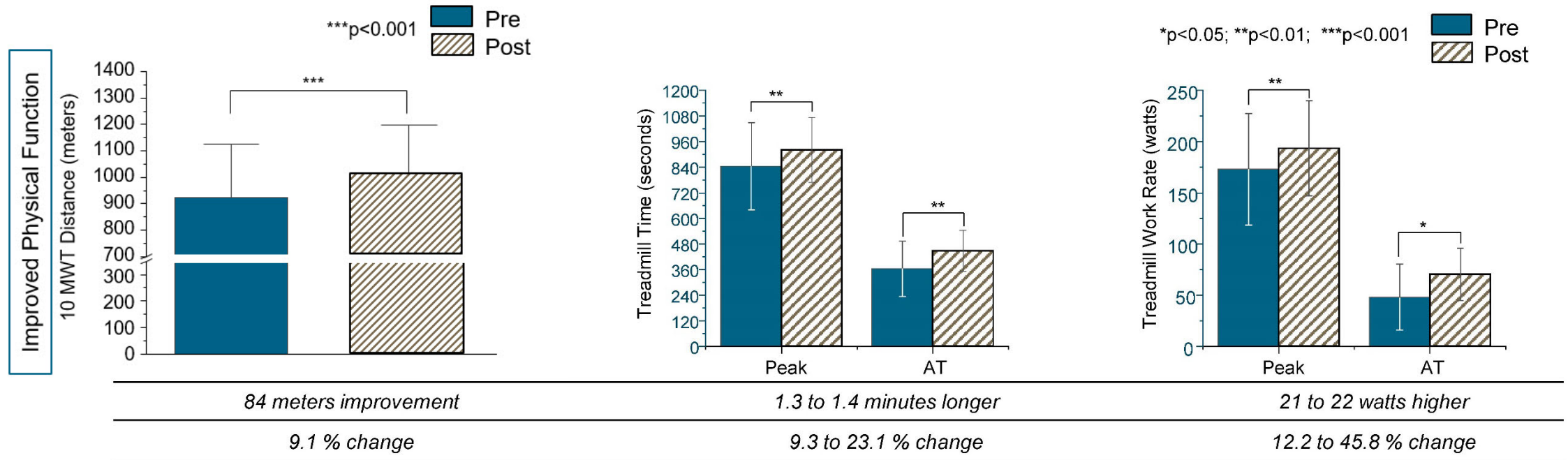
Preliminary findings

Overview of COVID-CARE

- RMD (NHLBI, NINR, NIAMS, NIBIB, NCCIH)
- Is aerobic exercise training beneficial for improving functional outcome and recovery among survivors of COVID-19?
- 90 adults recovering from COVID-19 with residual physical limitations or fatigue
  - 6MWT is primary outcome
  - Secondary: physical function, QOL, physical activity, sleep quality
  - Vascular function
  - Blood biomarkers

Screening Phase → **Consent/Enrollment** ⇢ History and Physical

Consent/Enrollment → **Inclusion** → **Baseline Assessments**

10 Weeks: **Block Randomization** — AET+ (AET + Edu) | CON (Control; Edu only)

→ **Follow-up Assessments**

AET+ finished | Begin AET for 10 weeks (either on-site or remote)

→ **Follow-up Assessment** → CON finished

Assessments

1. **Clinical**
   - Echo, ECG, PFT, biospecimen collection
2. **Imaging**
   - Chest CT, *Brain MRI†*, Neuromuscular Ultrasound
3. **Physical Function/Performance**
   - 6MWT*, SPPB, CPET
4. **Patient-reported Outcomes**
   - SF-36, EQ-5D-5L, PROMIS, Neuro-QOL (QoL)
   - FSS, VAS-CFS# (fatigue, post-exertion malaise)
   - IPAQ (Physical activity)
   - BDI-2, IES-R (Depression, PTSD)
   - PSQI (Sleep)
   - CRISIS (COVID-19-specific)
   - EPII (Pandemic specific)
   - PGAC (Global Change)
5. **Neurological Assessment**
   - RBANS (Cognition)
   - UPSIT (Olfactory Test)
6. **Accelerometer**
   - Physical activity, sleep quality
7. **Vascular Function**
   - PWA, CAVI, PAT [standard]
   - ABI, NIRS with occlusion, optical imaging, lower extremity ultrasound† [supplemental]
   - *Skin Biopsies*

baseline only†; primary outcome*; *optional*; questionnaire not assessed during 1-year follow-up#

1-year Follow-up: Following completion of exercise training, participants are mailed an accelerometer and contacted every 3 months for 1 year to examine continued free-living physical activity, sleep quality and QOL changes over time.

Highlights 2014-2020

- RMD published 250 peer reviewed papers (one paper every 10 days)
- Subject Recruitment
  - Brought 1,200+ outpatients into the CC
- Entrepreneurial: 65% of $6 million research budget from outside NIH
  - Agreements with the DoD ($700k/yr) and SSA ($2-4 million/yr)
- RMD efforts have contributed to advances in disability assessment, pulmonary hypertension, SLE, cerebral palsy, TBI biomarkers, Havana Syndrome
- We have pivoted our exercise science team to study patients recovering from Covid-19

Question?