

Long COVID: Pragmatic tips for treatment, assessment and care of patients

David Putrino, PT, PhD

Professor of Rehabilitation and Human Performance

Director of Rehabilitation Innovation

Director, Abilities Research Center

Director, Charles Lazarus Children's Abilities Center

Director, Performance360

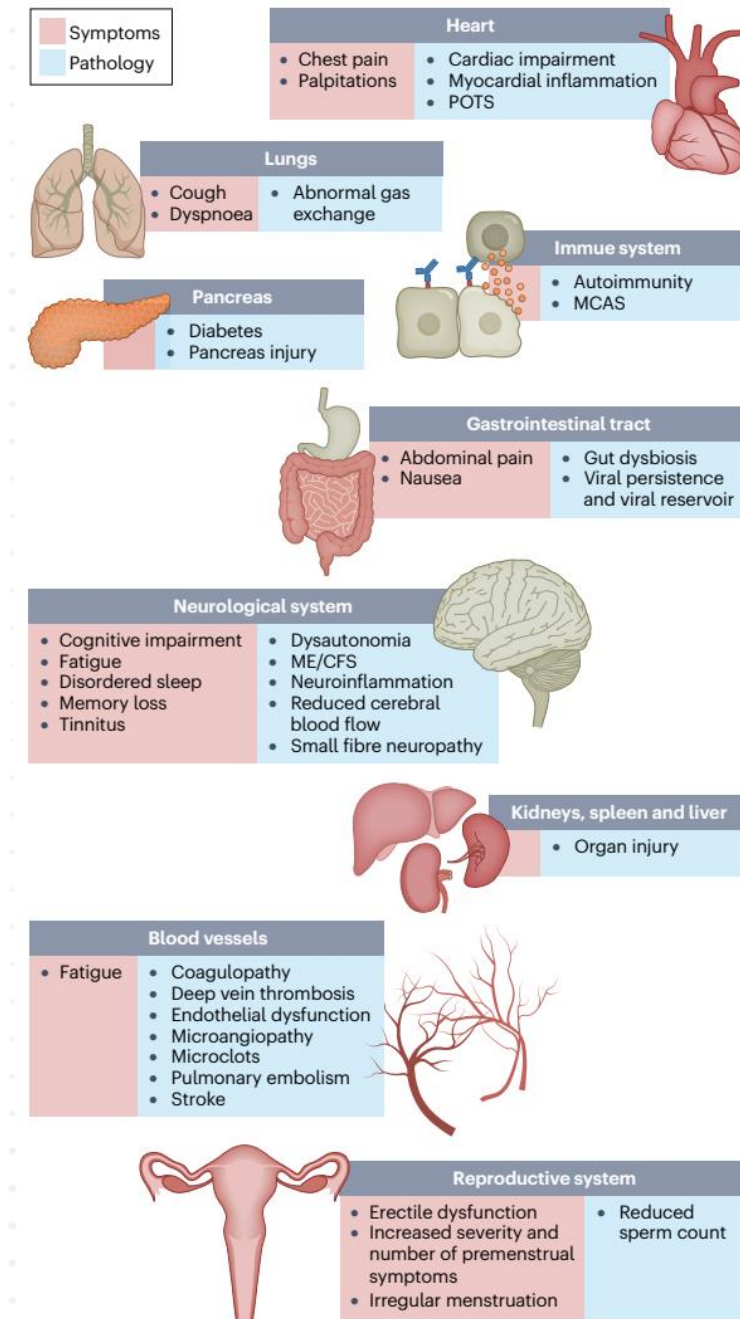


Mount Sinai

Nothing to disclose

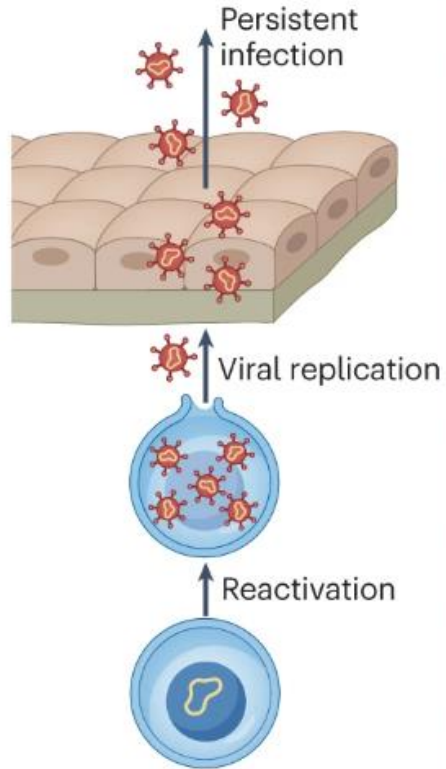
Long COVID: What it is and what it isn't

- Long COVID is **NOT** a functional disorder
- Long COVID is a condition that can result in measurable and evident damage to the body, OR subtle organ dysfunction requiring specialty testing. Both can result in serious and debilitating symptoms.
- Long COVID has widespread and insidious impact on the body
- Some mechanisms for organ dysfunction and symptoms have been identified, others remain unknown



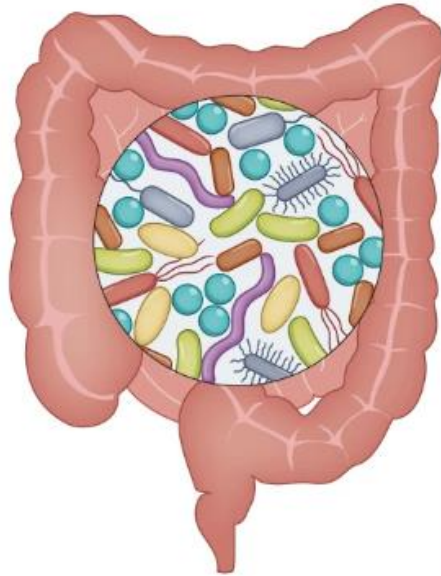
Some of the proposed underlying causes of Long COVID pathology

Immune dysregulation



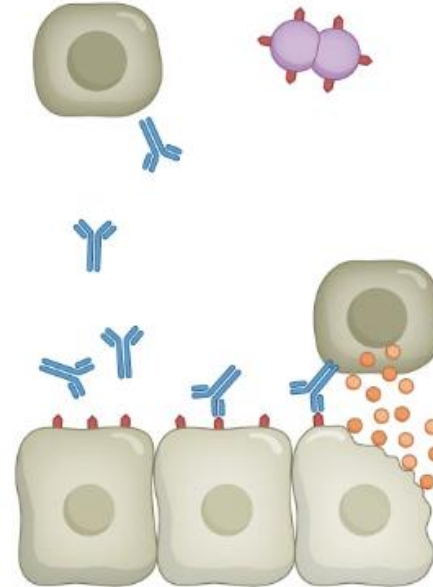
Immune dysregulation, with or without reactivation of underlying pathogens, including herpesviruses such as EBV and HHV-6

Microbiota dysbiosis



Impacts of SARS-CoV-2 on the microbiota and virome (including SARS-CoV-2 persistence)

Autoimmunity and immune priming



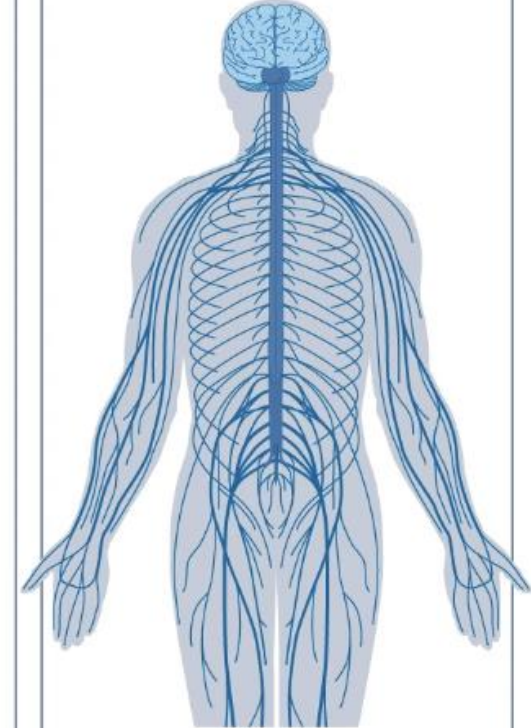
Autoimmunity and primed immune cells from molecular mimicry

Blood clotting and endothelial abnormalities

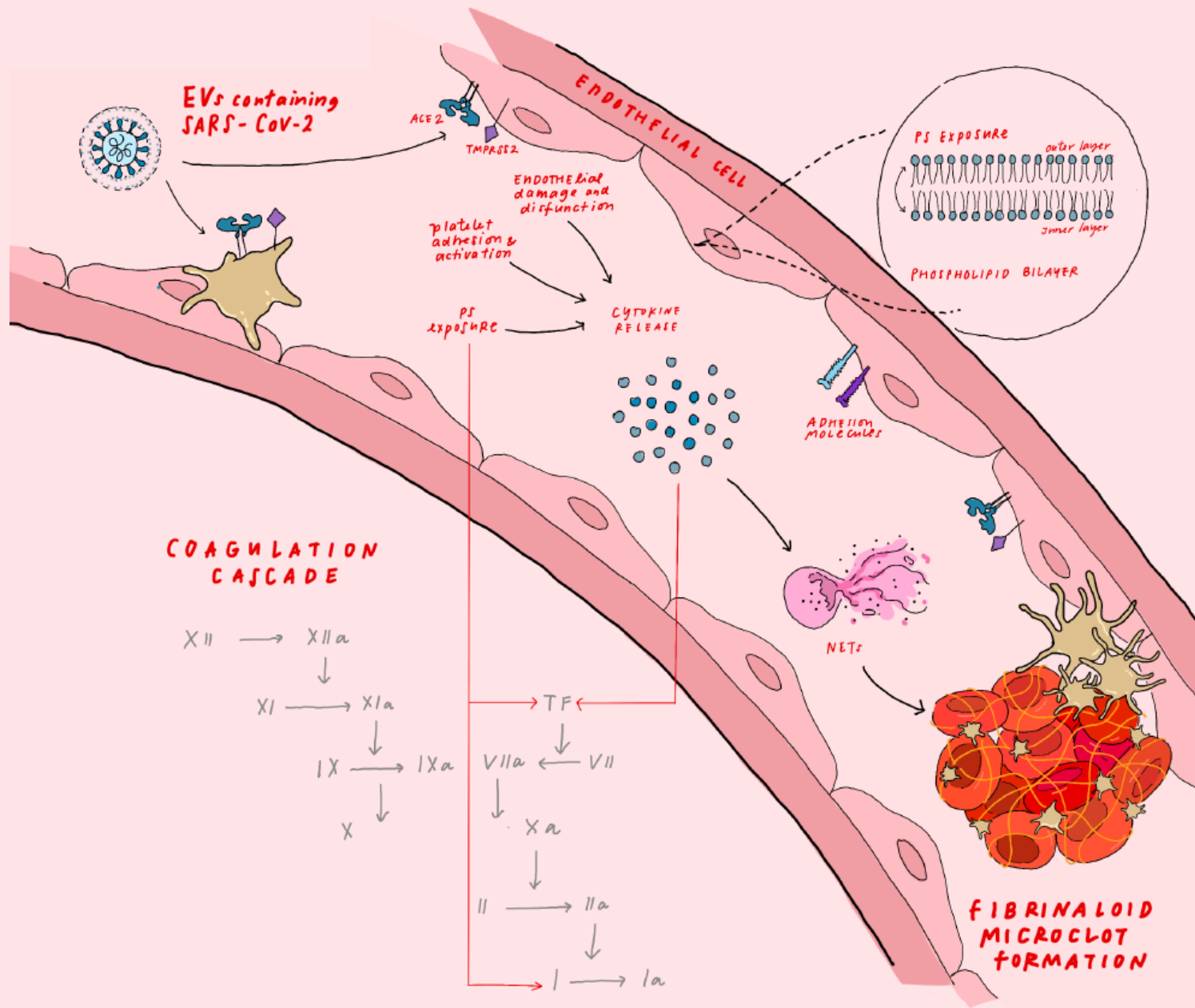


Microvascular blood clotting with endothelial dysfunction

Dysfunctional neurological signalling



Dysfunctional signalling in the brainstem and/or vagus nerve

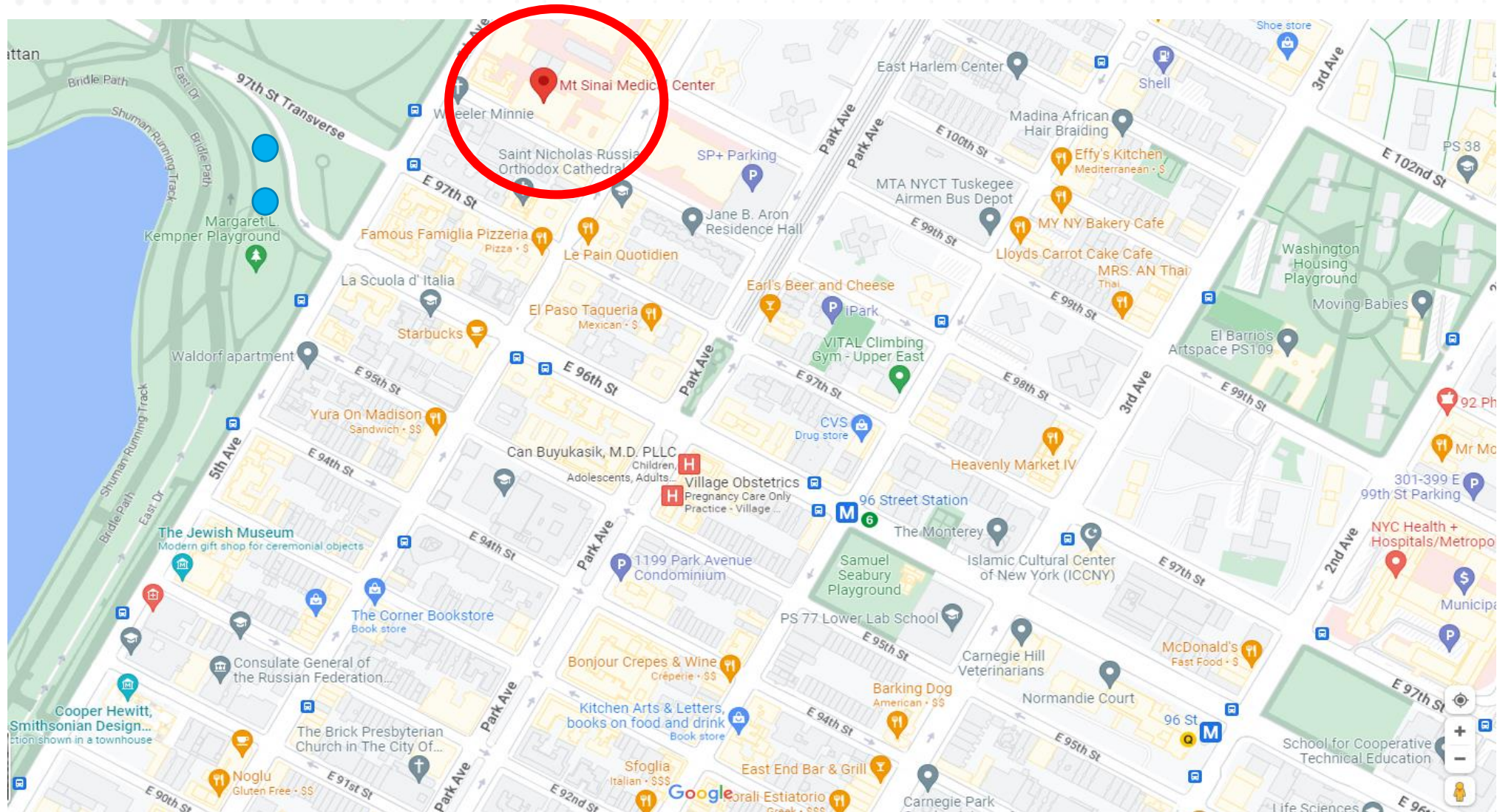


Many of these underlying causes can co-occur, creating similar signs and symptoms in different ways

Care
approaches
to complex
illness must
be *different*



Center for Recovery from Complex Chronic Illness (CoRE)

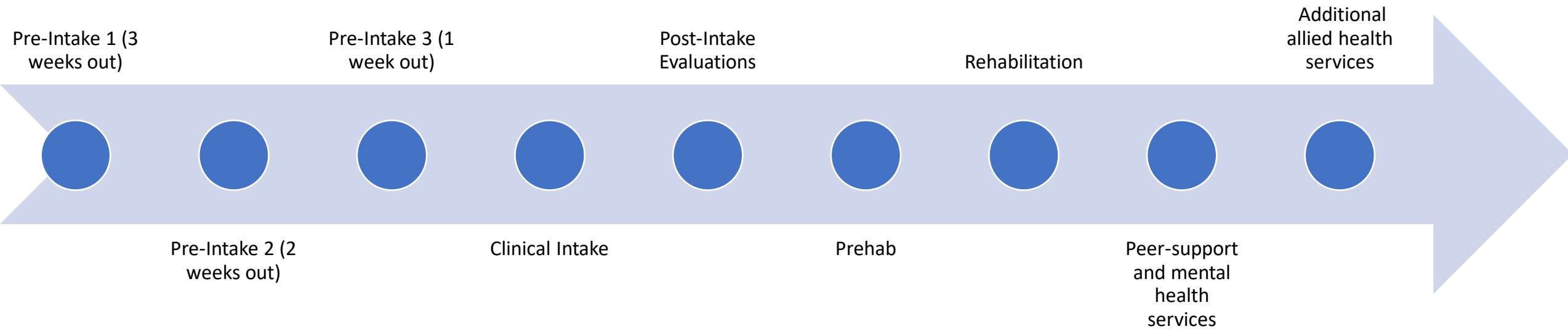


Steps toward a comprehensive Long COVID clinical pipeline

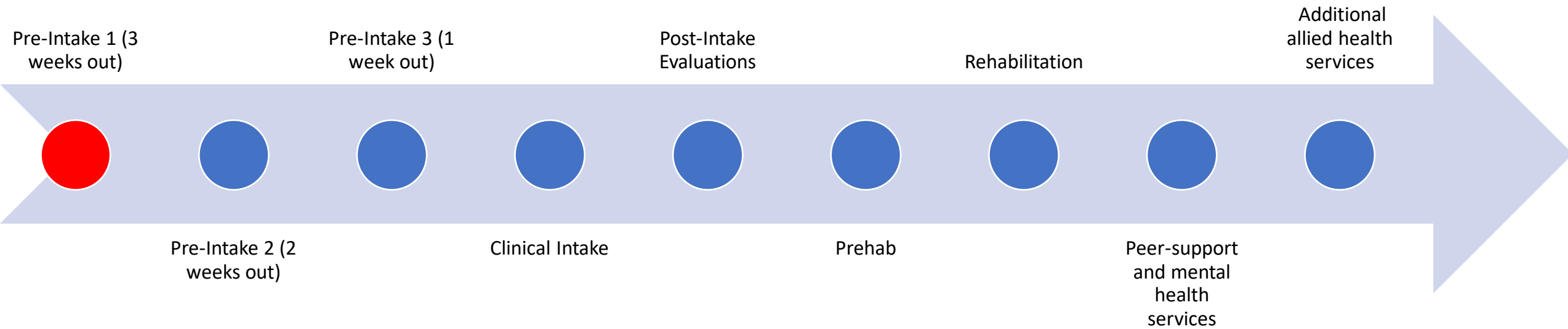


**Mount
Sinai
Hospital**

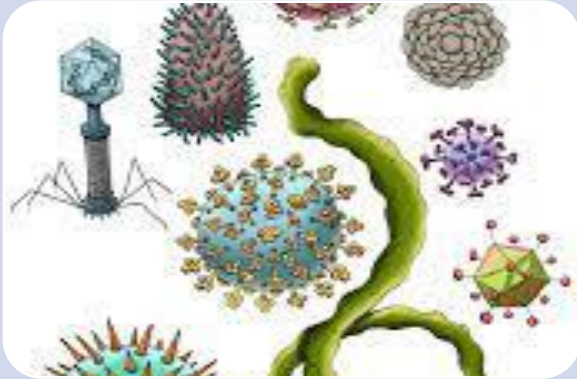
Our (simplified) clinical pipeline



Pre-Intake 1

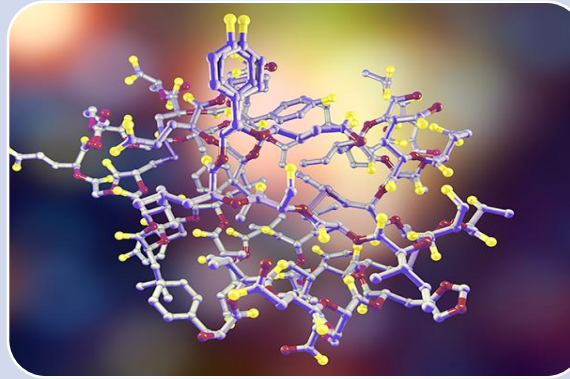


Pre-Intake Visit 1: Blood testing panels



CO-INFECTION:

- Herpes viruses
- HPV
- H Pylori
- Human metapneumovirus (HMPV)
- EBV
- Tick-borne/Vector-borne illness



HORMONES

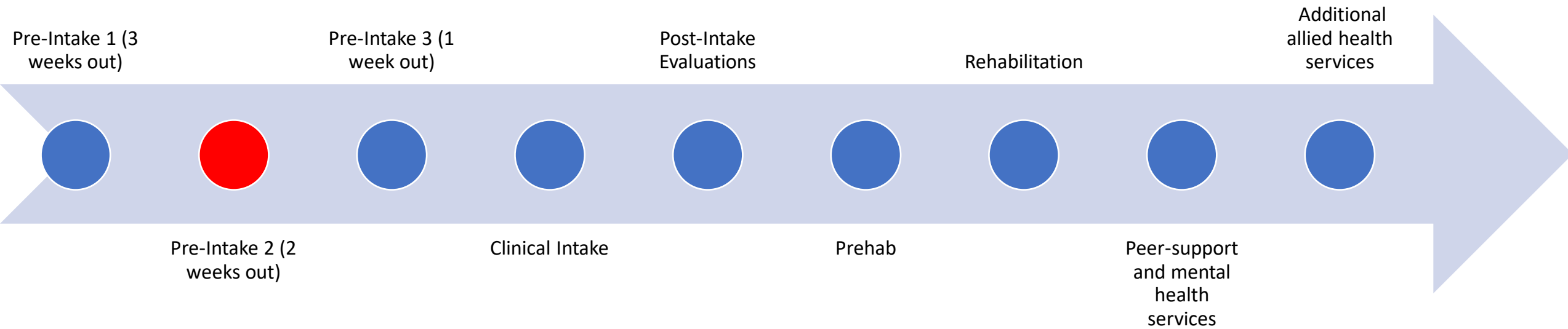
- Morning Cortisol
- Testosterone
- Estradiol
- Progesterone



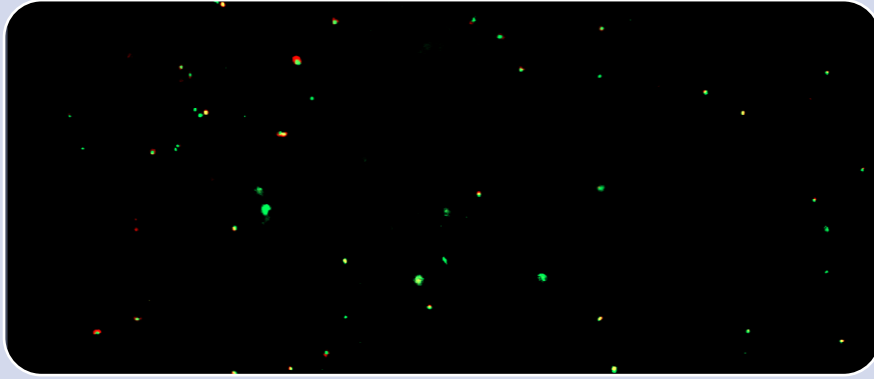
VITAMINS AND MINERALS

- Iron
- Ferritin
- Magnesium
- Vitamins

Pre-Intake 2



Pre-Intake Visit 2: Second round of blood testing panels



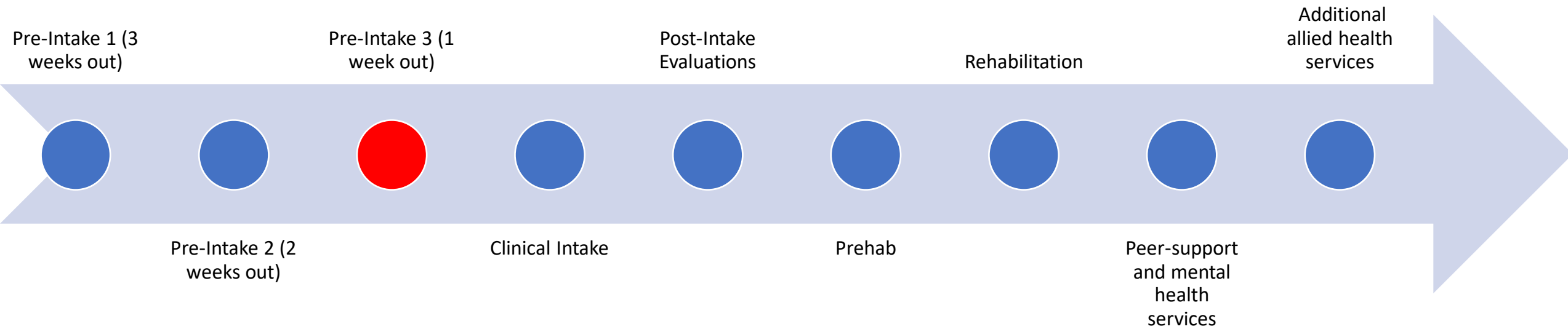
COAGULOPATHY AND PLATELET ACTIVATION:

- the Selectins
- D-Dimer
- Fibrinogen
- alpha-2 macroglobulin
- VCAM-1
- Veg-F
- Von Willebrand Factor and FVIII

INFLAMMATION

- Interleukins (IL-1b, IL-2, IL-6, IL-8, IL-10, IL-13)
- SCD-40L
- TNF-a
- Interferon gamma
- TGF-b1 and TGF-b2
- Chemokines (CCL-5, CCL-11)
- Pro-calcitonin
- G-CSF

Pre-Intake 3



Pre-Intake Visit 3: Symptom burden evaluation using patient-reported outcomes



DEMOGRAPHICS

- Age
- Gender
- Race and Ethnicity
- Insurance status
- Employment status (pre- and post-Long COVID)
- Disability status
- Education level

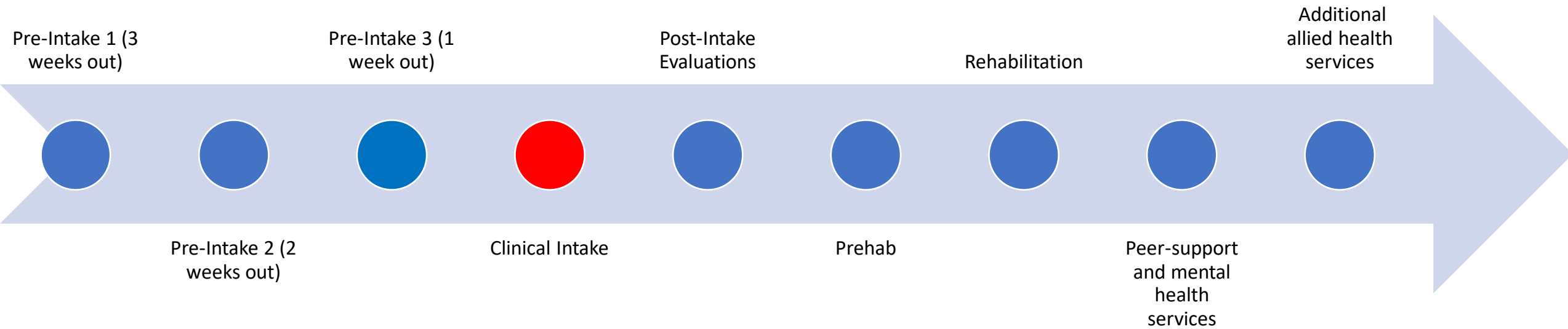
MEDICAL HISTORY

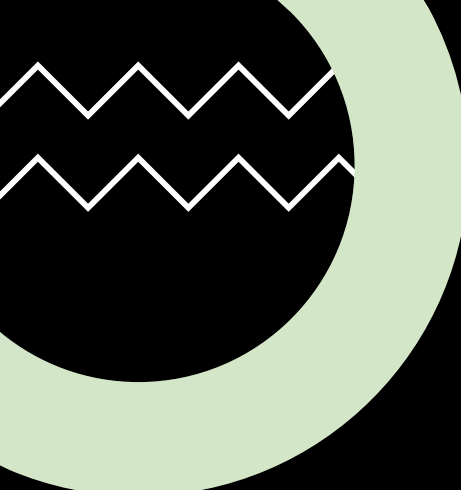
- Past Medical History
- Vaccine Status
- Diagnosis method for acute COVID
- Symptom List
- Known symptom triggers
- Physical activity levels (pre- and post-Long COVID)

PATIENT REPORTED OUTCOMES

- Euro-QOL 5 dimensions (EQ-5D-5L)
- MRC Dyspnea Scale
- Fatigue Severity Scale (FSS)
- Patient Health Questionnaire (PHQ-2)
- Generalized Anxiety Disorder-7 (GAD-7)
- Pain Numeric Rating Scale NRS
- Self-Reported Leeds Assessment of Neuropathic Symptoms and Signs (S-LANSS)
- Sleep Numeric Rating Scale
- Epworth Sleepiness Scale (ESS)
- PROMIS Ability to Participate in Social Roles and Activities 8a
- Neuro-QOL Cognitive Function 8a
- DePaul Symptom Questionnaire/Post-Exertional Malaise (DSQ-PEM)

Intake Exam



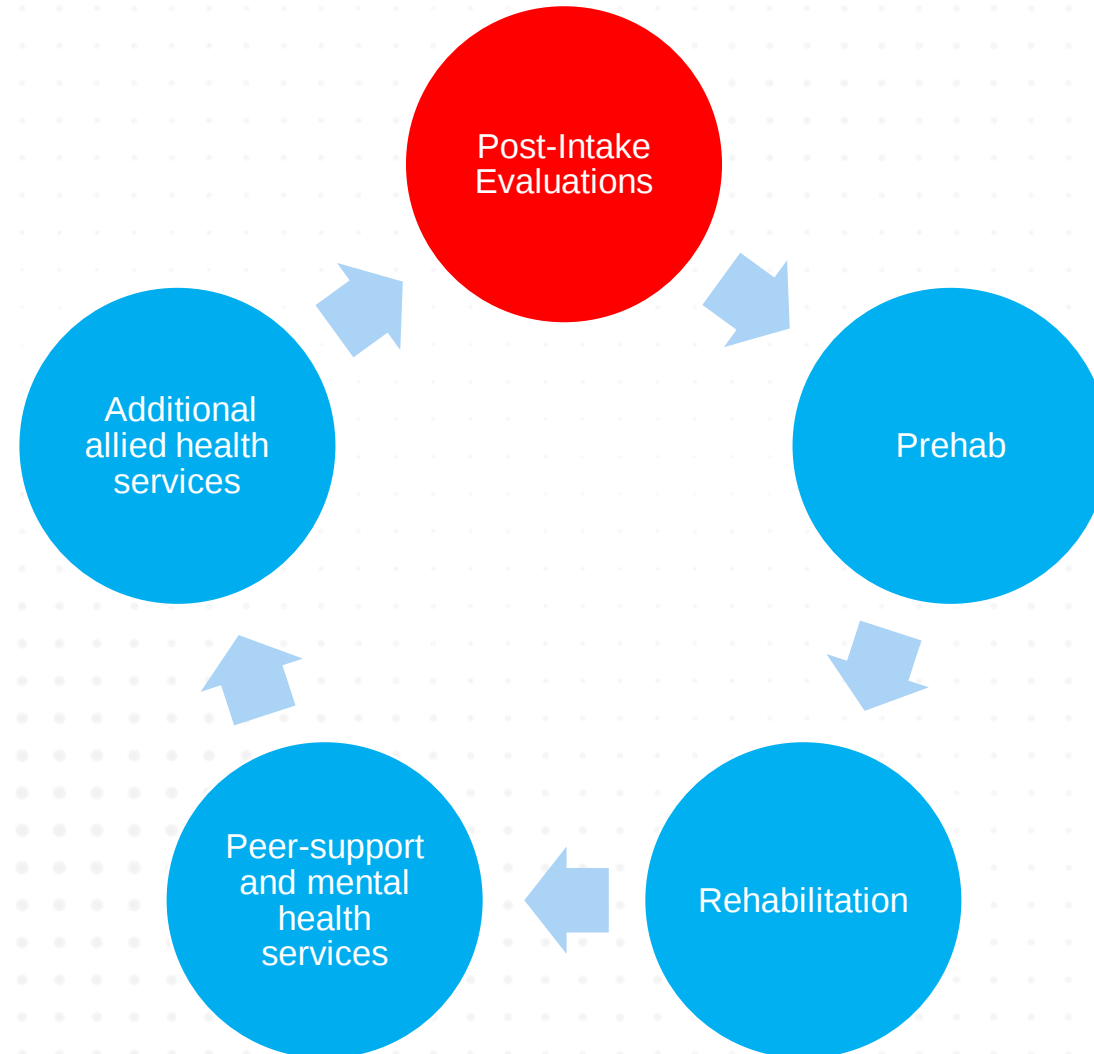


Clinical intake exam

- Typically a one-hour consultation
- Detailed discussion of test results from pre-intake sessions
- Personalized interventional plan based on testing



Post-intake

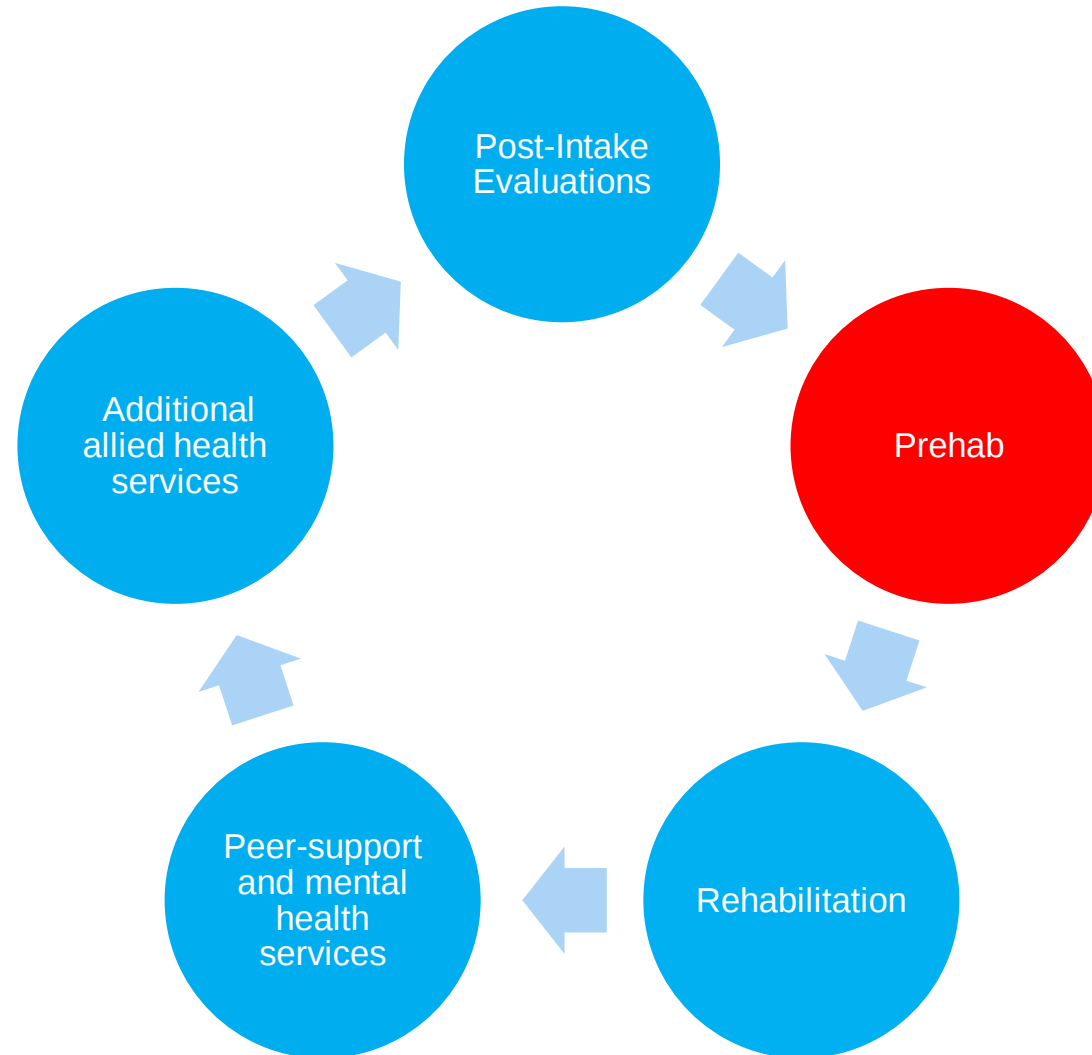


Post-intake Assessments (as needed)

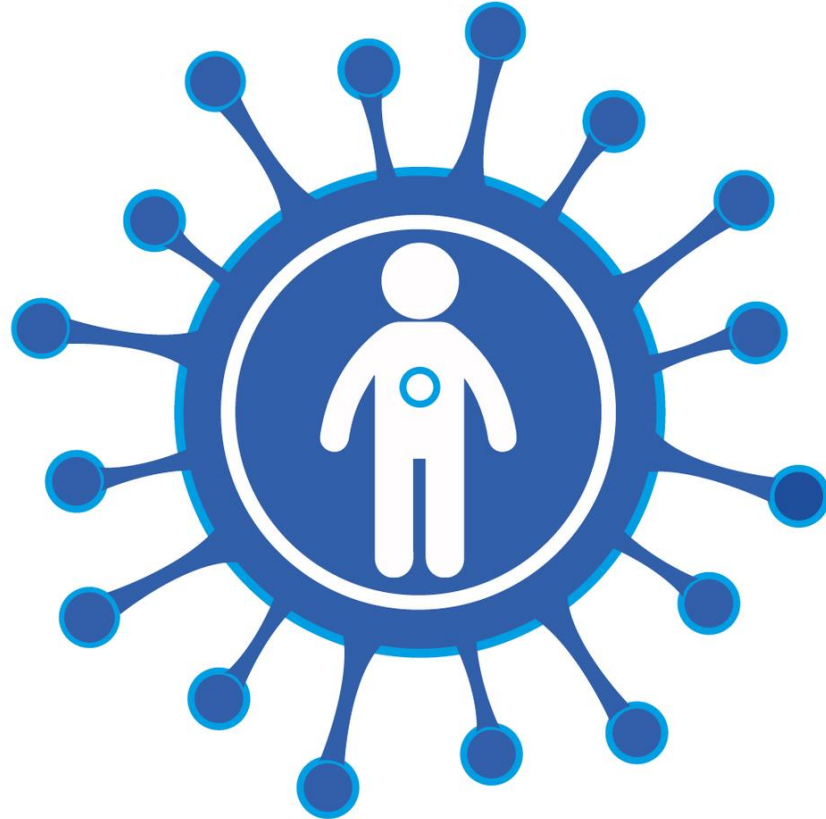
- Echocardiogram/EKG
- Pulmonary function test
- Chest CT
- Endoscopy
- Colonoscopy
- Cognitive Assessment (BrainCheck)
- Microclot and platelet hyperactivation evaluation (under the auspices of an IRB-approved clinical trial)
- Neurological Assessment (NeuroCatch)
- Autonomic testing (transcranial doppler, sudomotor testing, tilt table test and orthostatic testing)
- Resting metabolic rate and lactate thresholding



Post-intake



Prehab 1: Symptom management resources and conversations with patients about how best to avoid flares

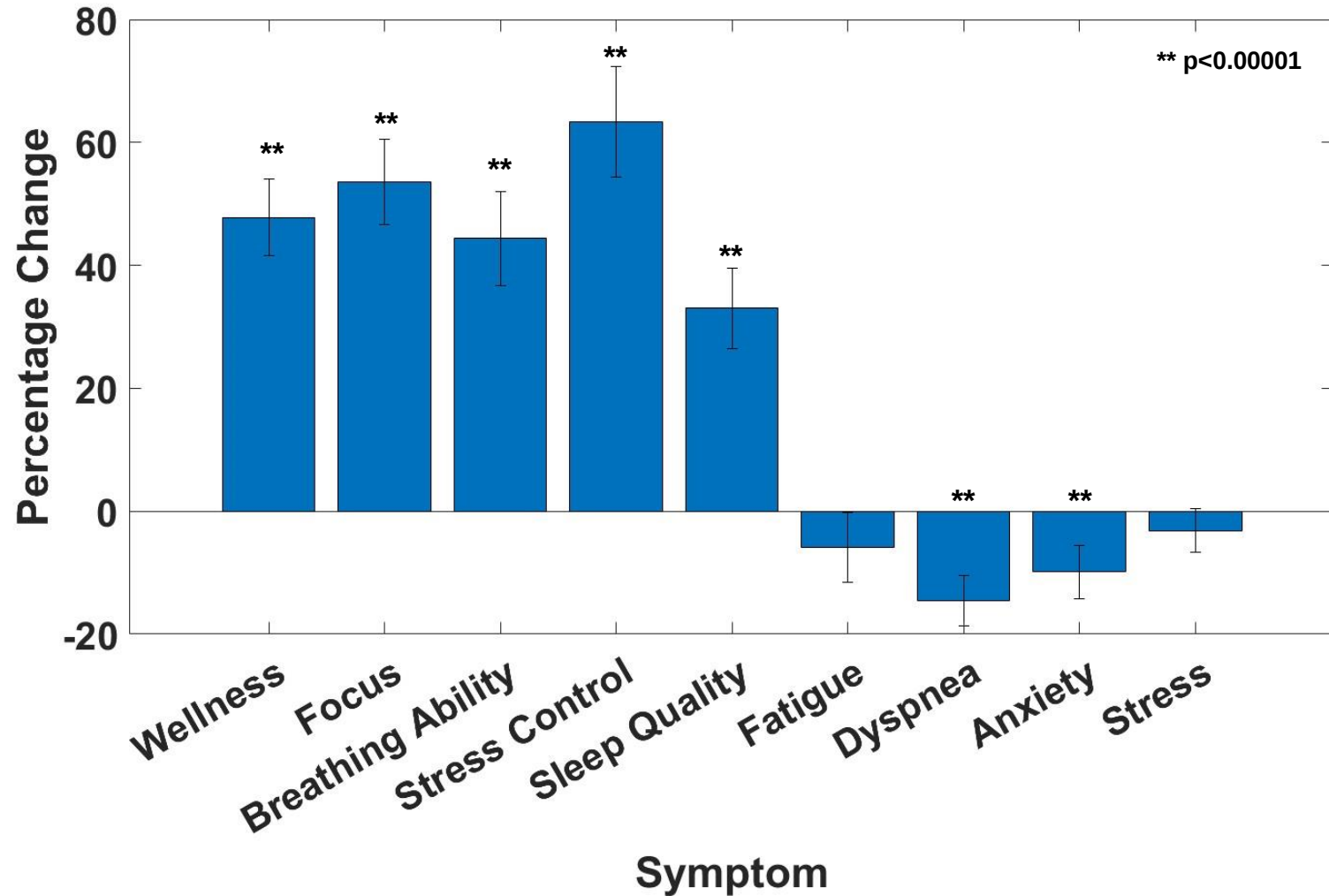


**LONG
COVID
PHYSIO**

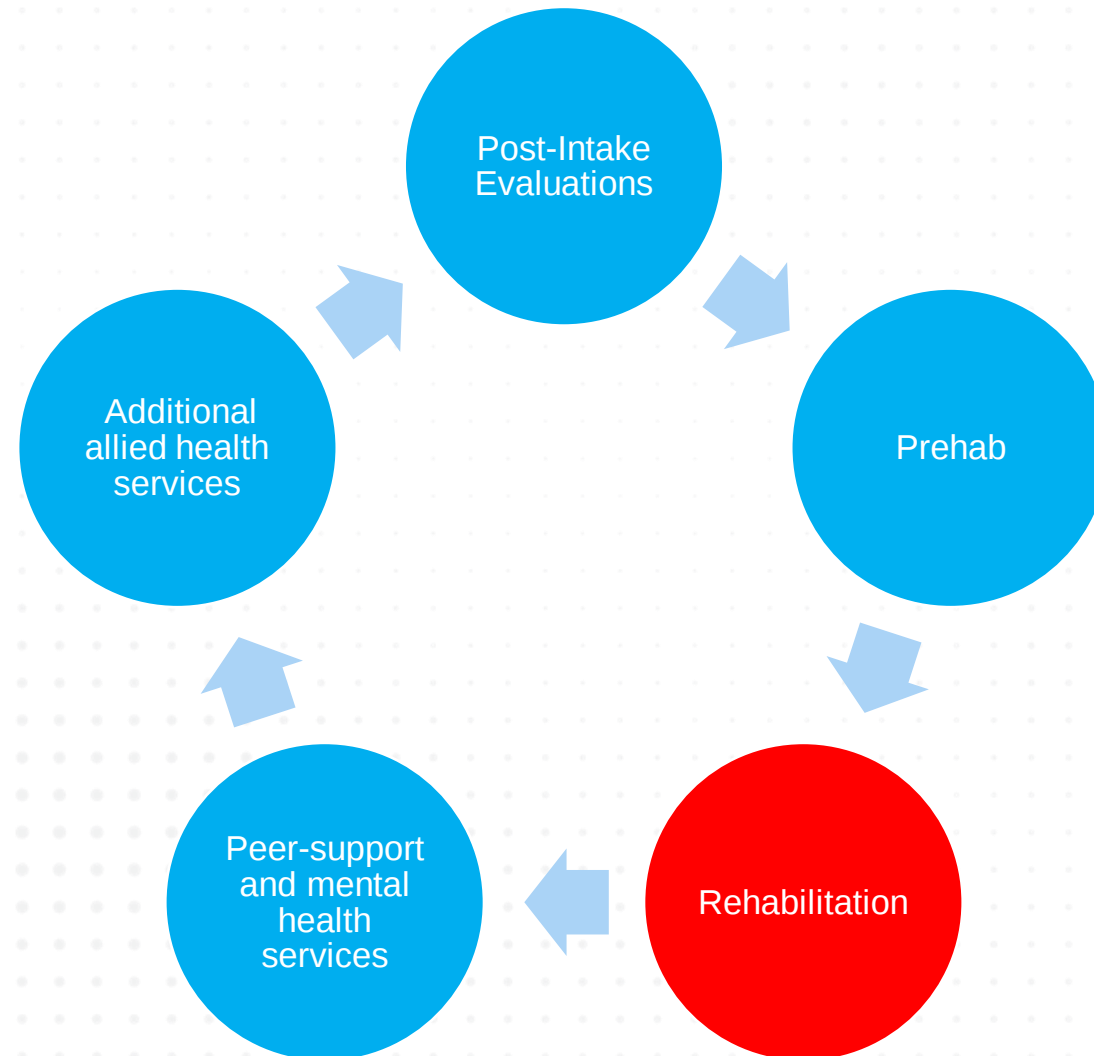


Prehab 2: Breathwork

- We work with the Stasis breathwork program
- Focus on increasing CO2 levels and reducing sympathetic nervous system activity
- Data from n = 112 participants
- 89% of participants showed *at least* some improvement ($p < 0.0001$)
 - 38.5% reported “much improved”
 - 12% reported “very much improved”
- Strongly significant improvement in multiple symptom areas



Post-intake



Autonomic Rehabilitation



Autonomic rehabilitation IS NOT:

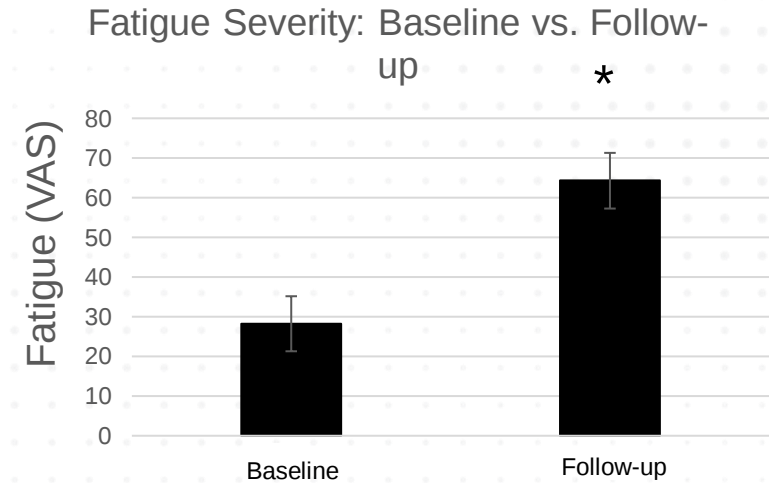
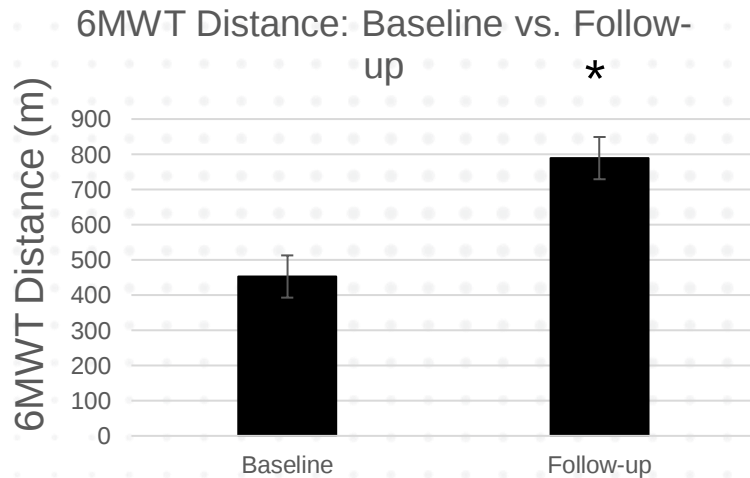
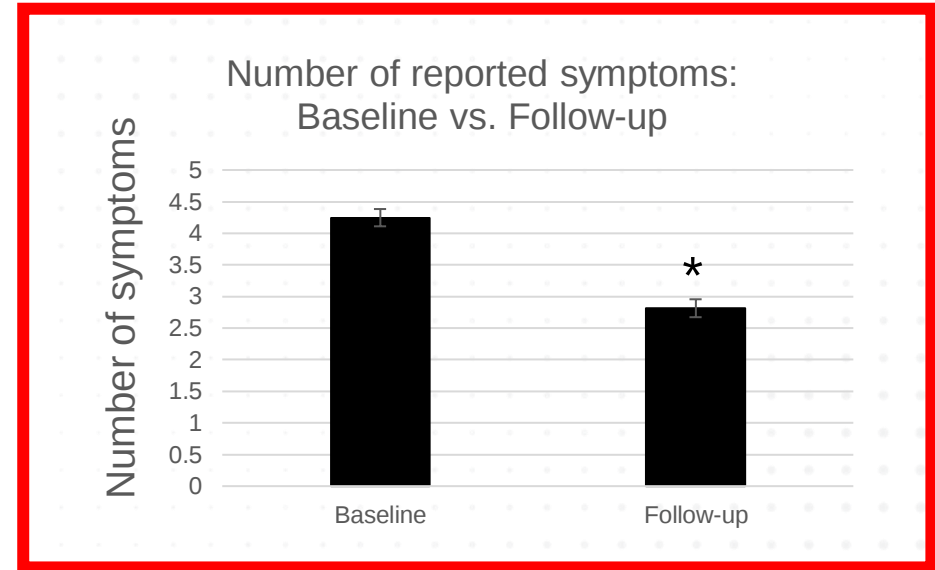
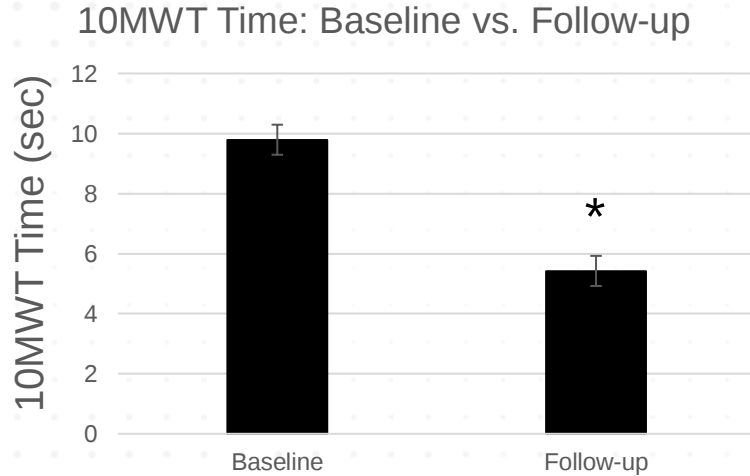
- A treatment for “deconditioning”
- Graded Exercise Therapy
- A “cure-all” for Long COVID: responses are variable

Autonomic rehabilitation IS:

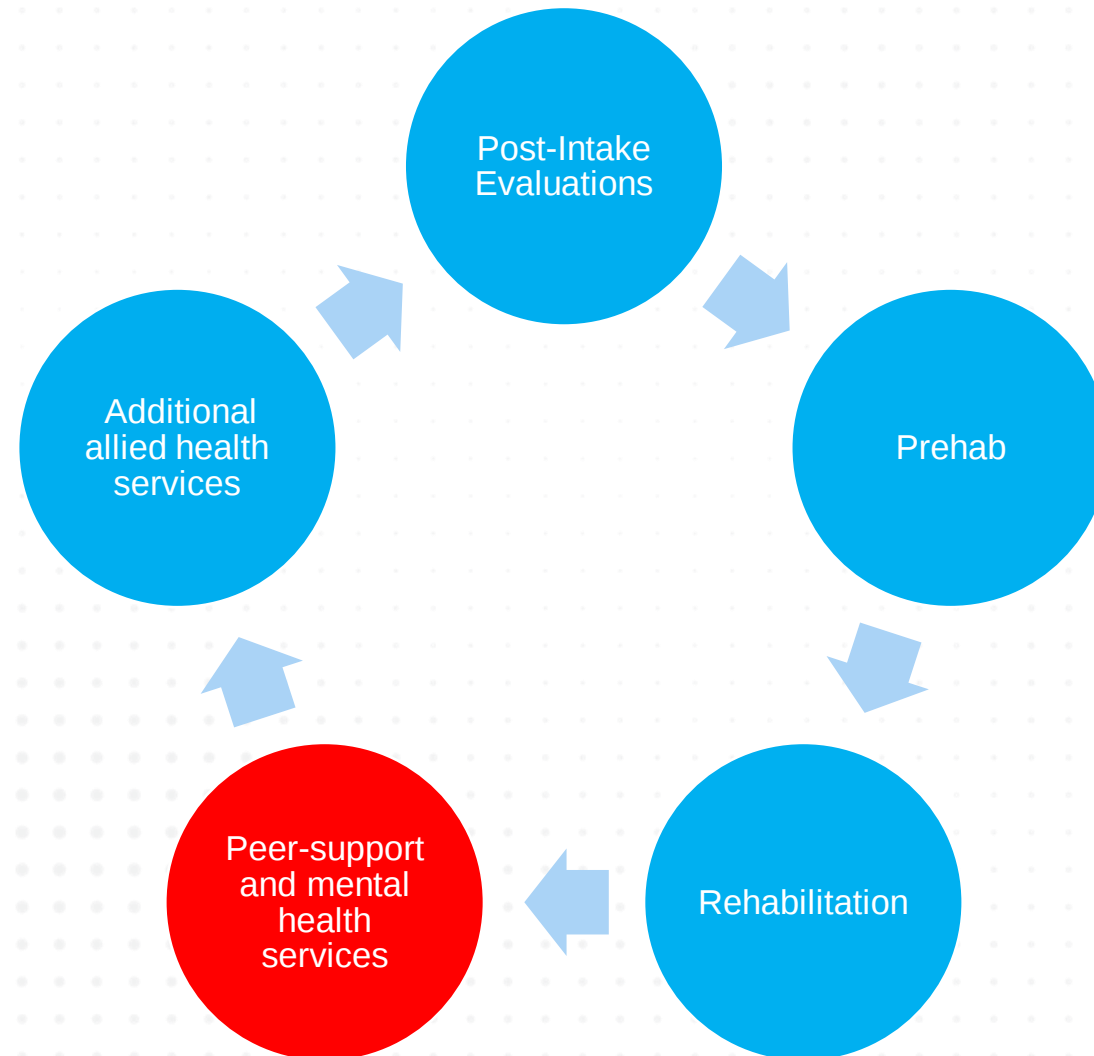
- A specific form of rehabilitation for the autonomic nervous system
- Often non-aerobic and **may not** progress to aerobic
- Always symptom-titrated: listen to your patients and their reporting of post-exertional symptoms
- Supported with medications when rehabilitation alone is not producing meaningful results



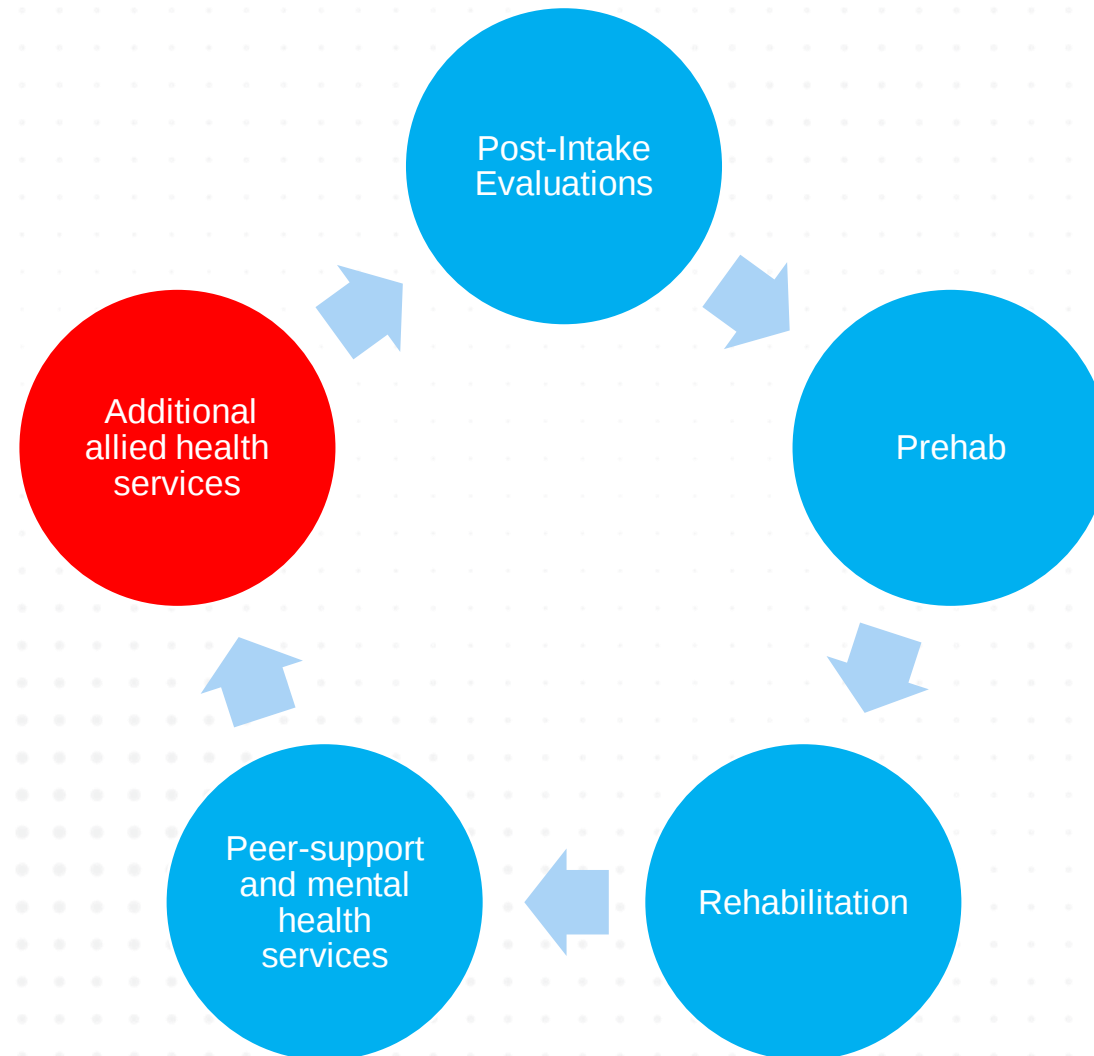
Results: Autonomic rehabilitation eases Long COVID symptoms and improves function (n = 500)



Post-intake



Post-intake





Final Thoughts

- We firmly believe that learning about how different complex chronic illnesses are similar and different is extremely important
- As such, our Long COVID center also sees patients with:
 - Myalgic Encephalomyelitis
 - Chronic Lyme Disease/Long Lyme
 - Ehler's Danlos Syndrome
- There is incredible value to learning where these illnesses align and deviate so that we can improve personalized and precision approaches
- We have a lived experience advisory board that meets monthly, including people with all four conditions to provide guidance on all patient care and research initiatives

Our CME-accredited Long COVID course!



LongCOVID Rehabilitation Course



**A Guide for
Rehabilitation
Professionals**



Acknowledgements

Mount Sinai Team

Joe Herrera
Lori McKenna
Mariam Zakhary
Angela Riccobono
Dayna McCarthy
Saurabh Mehandru

Abilities Research Center

Jenna Tosto-Mancuso
Laura Tabacof
Jamie Wood
Mackenzie Doerstling
Patrycja Graczyk
Lily Cooke
Wade Hamilton
Mina Girgis
Marta Lapinska
Katie Malone
Gabby Rozanski

Long COVID Research Collaborators

Akiko Iwasaki
Amy Proal
Harlan Krumholz
Mike Van Elzaker
Resia Pretorius
Asad Kahn

Our caring doctors and therapists

Our amazing interns and past lab members

All of our patients and the incredible patient-led groups



RTW
Charitable Foundation

balvi.io



**Mount
Sinai**



@PutrinoLab