Management of POTS in an Adolescent Swimmer- A Case Study in Diagnosis and Early Management

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North Central College

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Learning Objectives

- Attendees will be able to:
  - Recognize characteristic signs and symptoms of POTS in an adolescent population to facilitate early diagnosis
  - Implement evidence-based treatment strategies to improve health-related quality of life for POTS patients
  - Apply the ICF framework to the lived experience of a patient with POTS.

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Conflict of Interest Statement

- I have no financial conflicts of interest to report
- My opinions are my own and may not be those of my employer
- I have a personal interest and knowledge in this case as it is one of a family member
  - A pseudonym has been used and no images of the actual patient are used in this presentation.

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Molly-Initial Case Presentation

- Fall 2020
- 16F secondary school swimmer c/o dizziness upon standing, “tunnel vision” with standing, sensation of racing heart, weakness, fatigue.
- Reports having several syncopal events while at home in last 2 weeks.
- Has experienced low level nausea and several bouts of vomiting, recurrent low grade fevers over the past several months.

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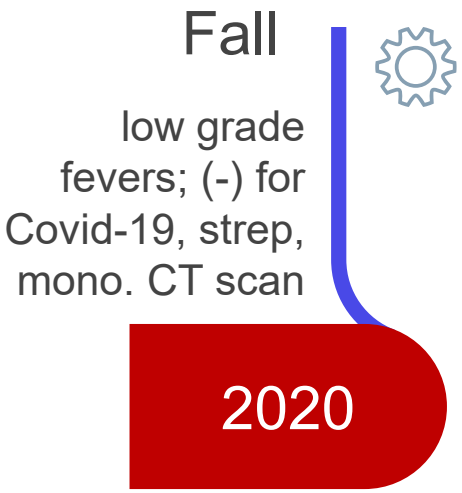
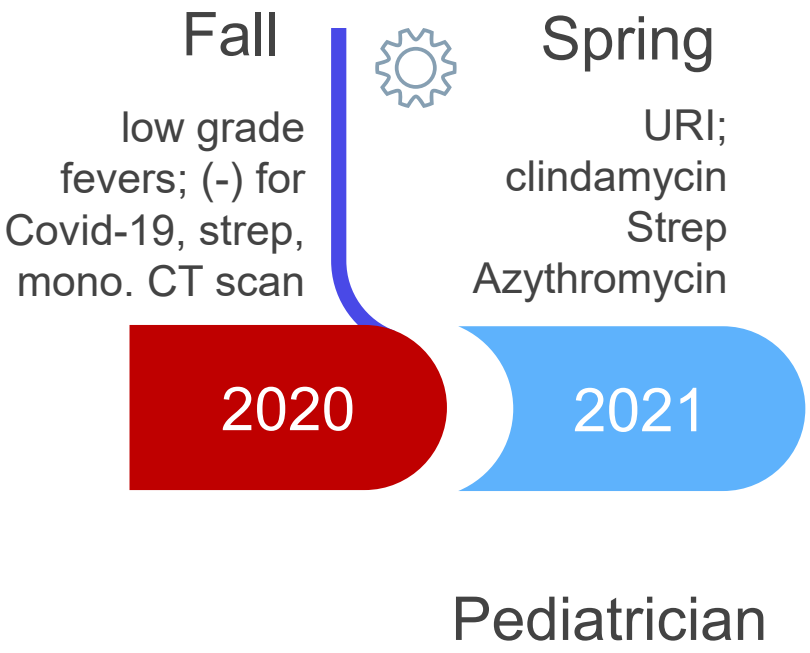
Timeline of Molly’s Case



Timeline of Molly's Case



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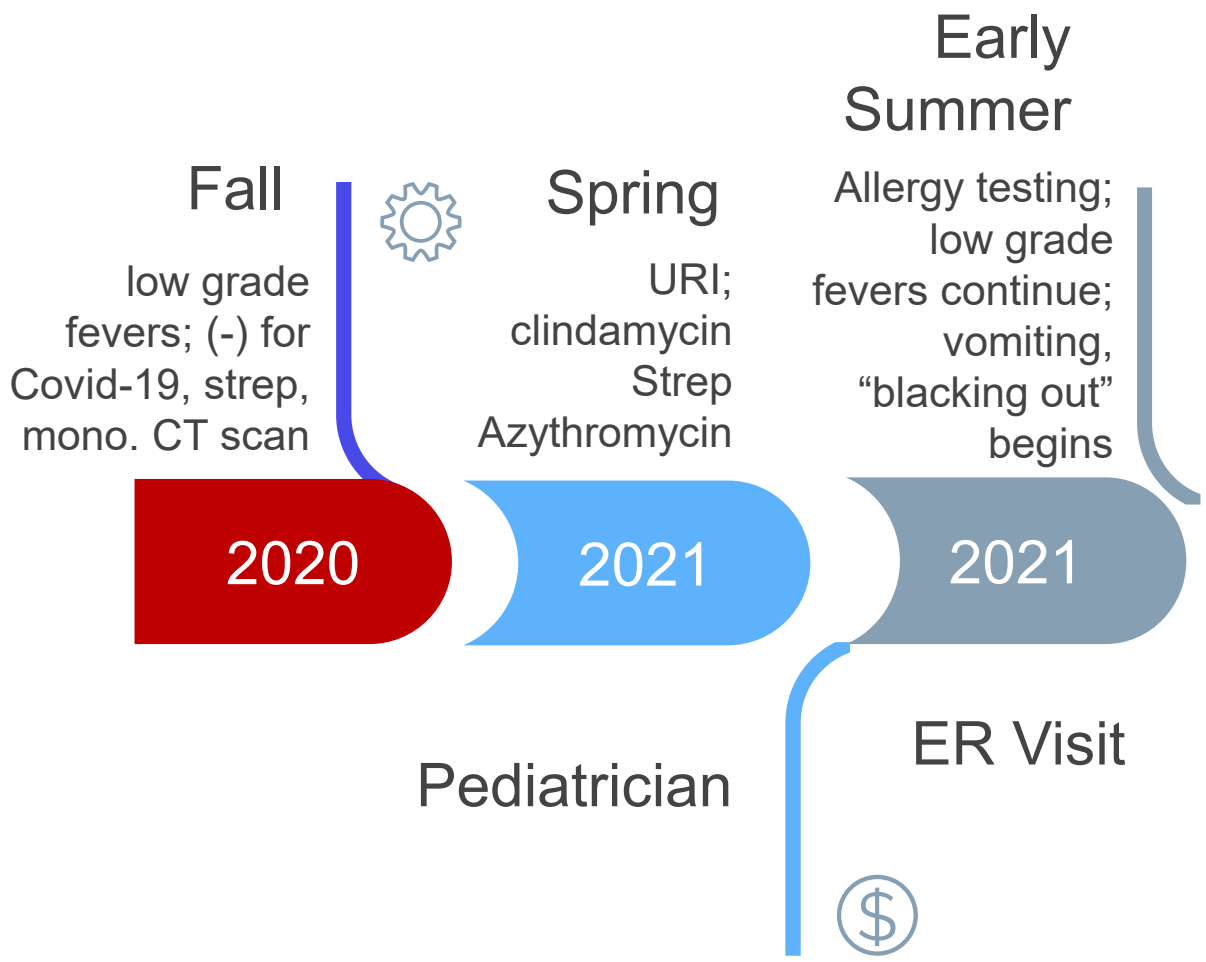

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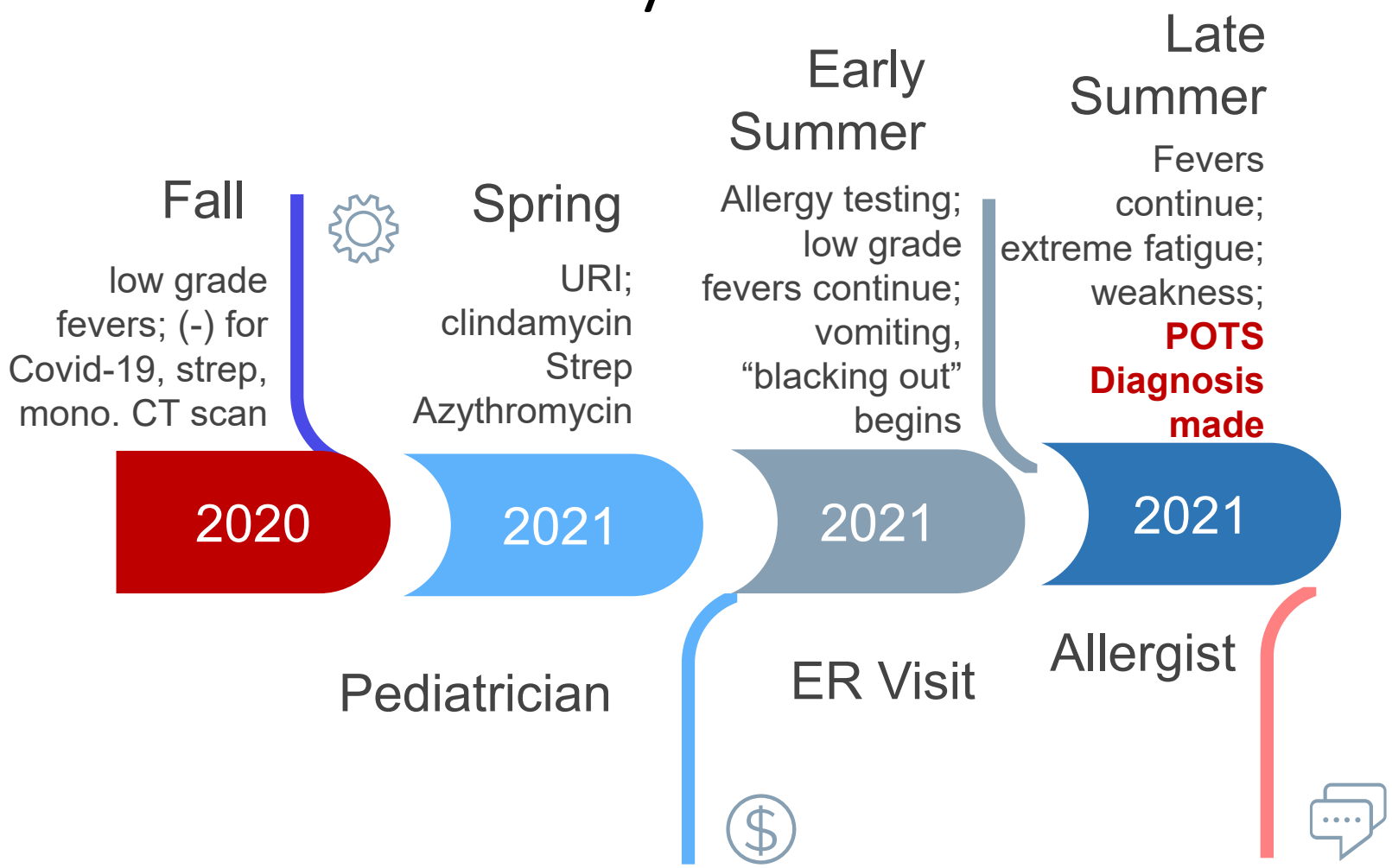

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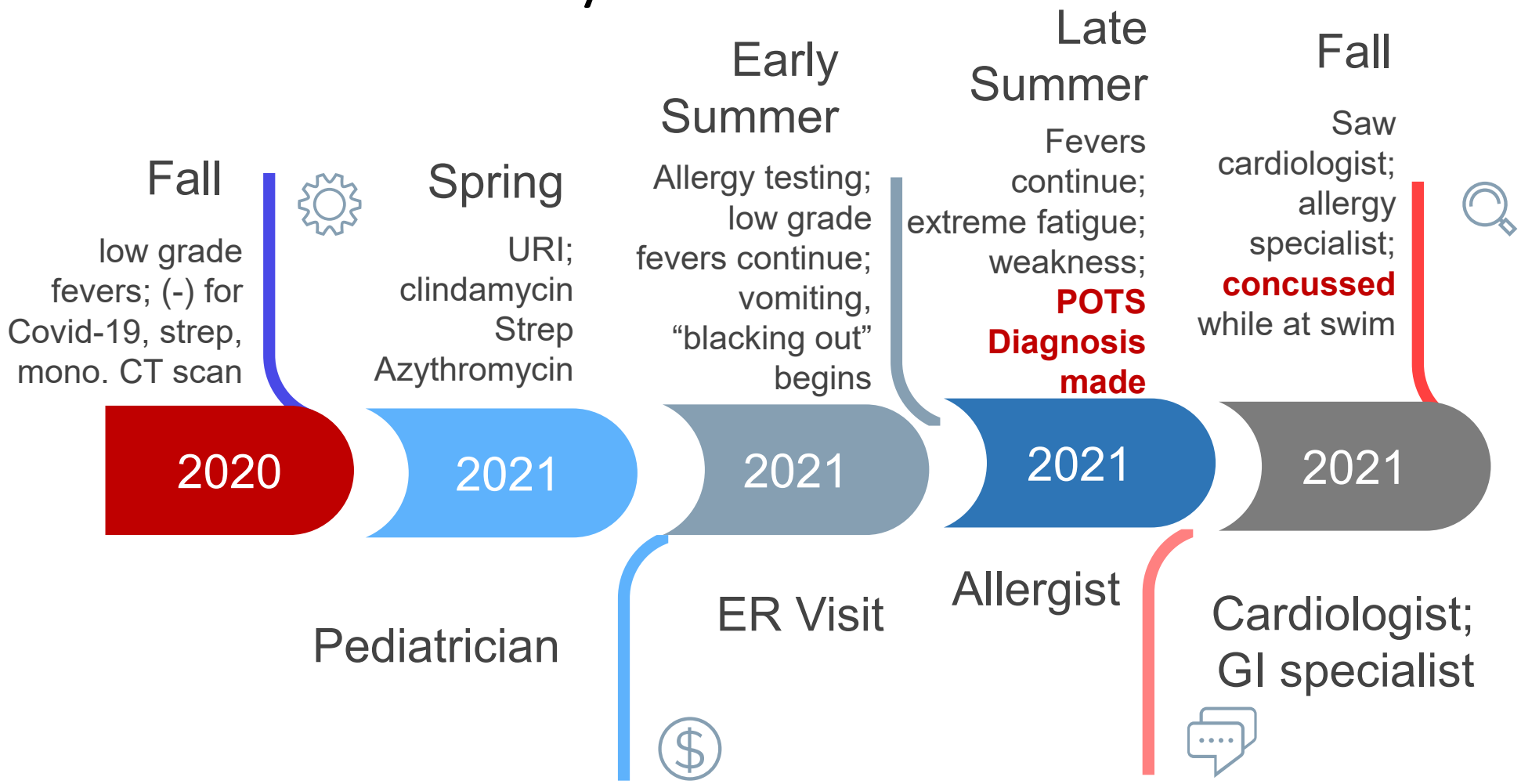

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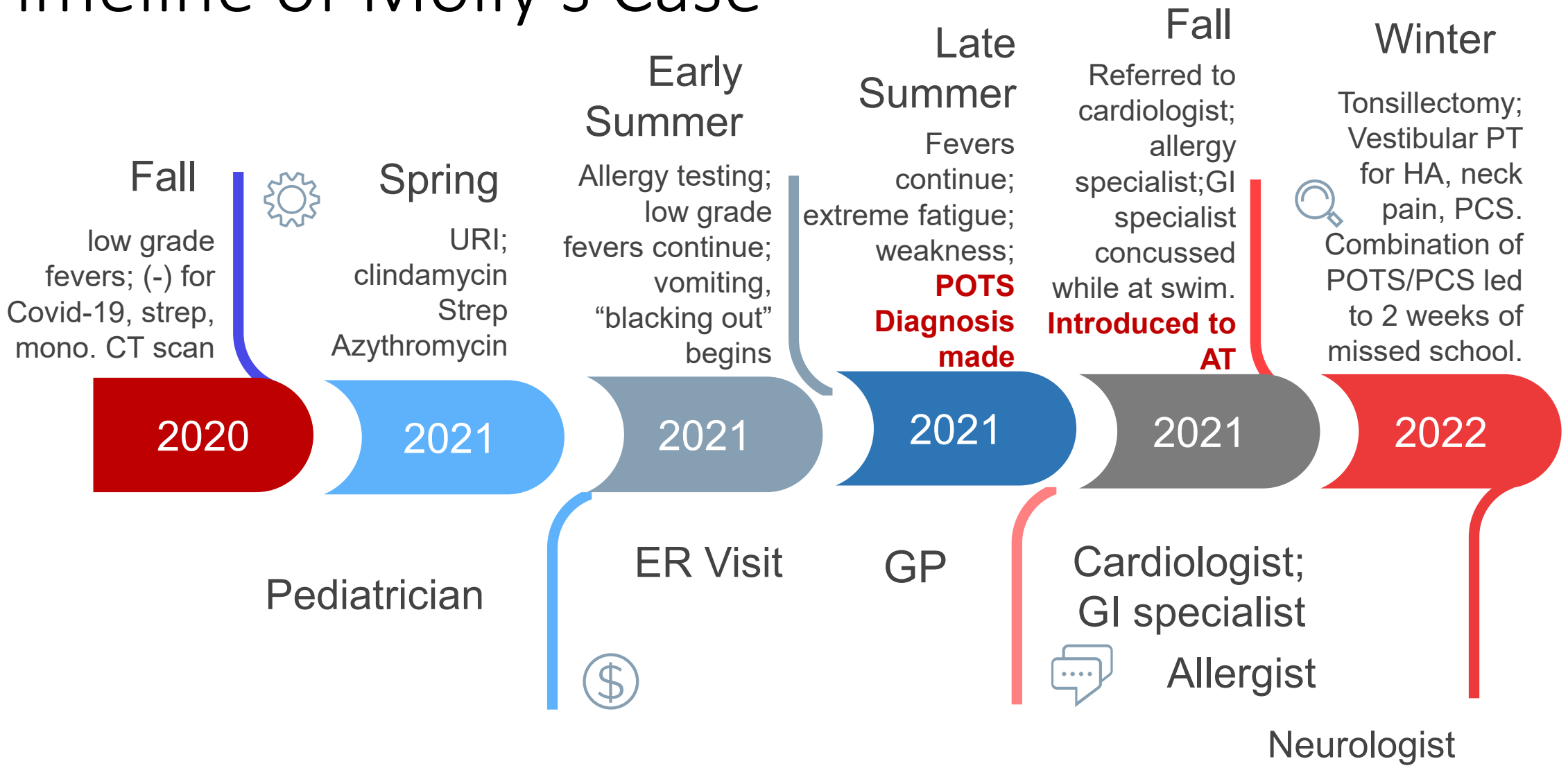

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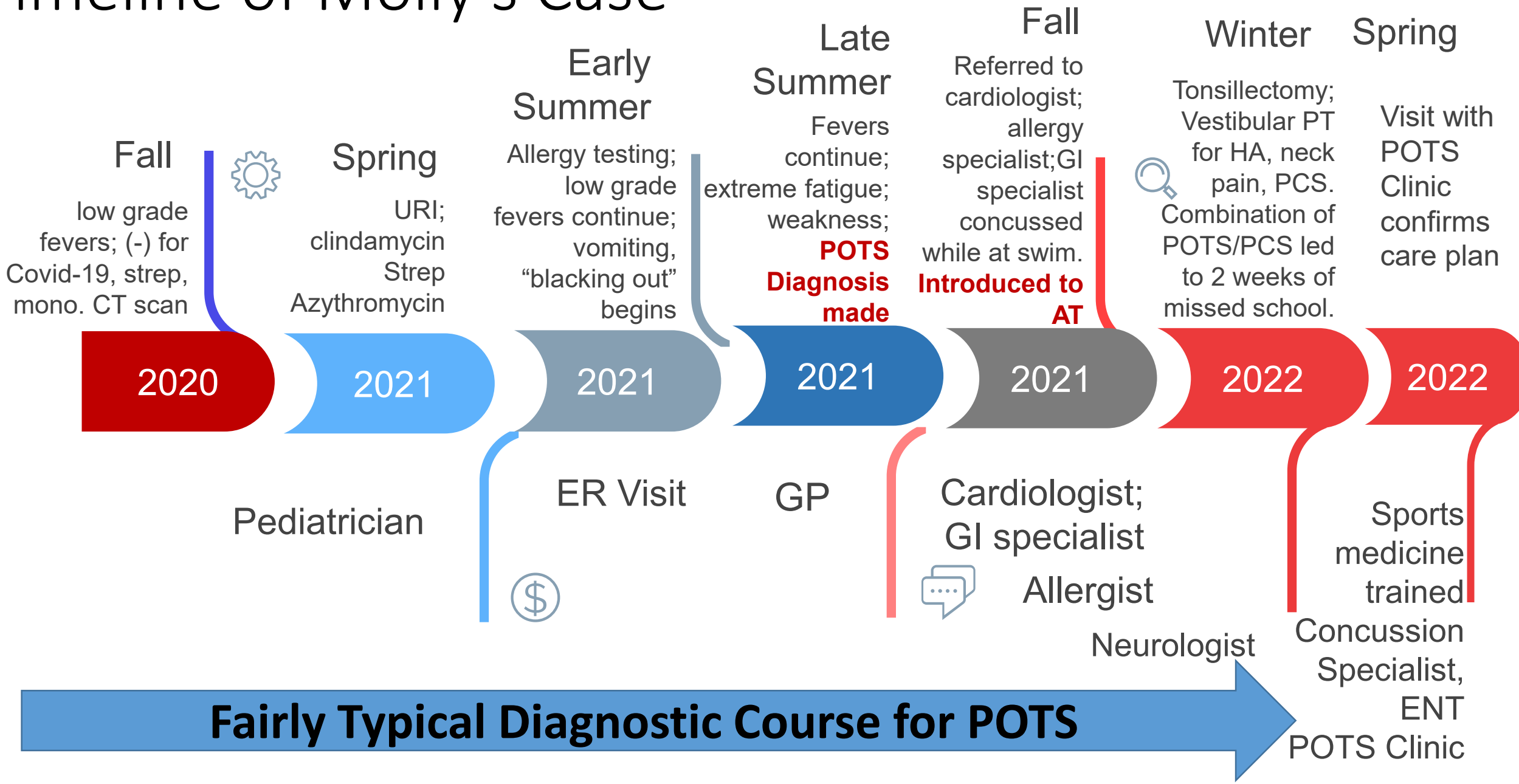
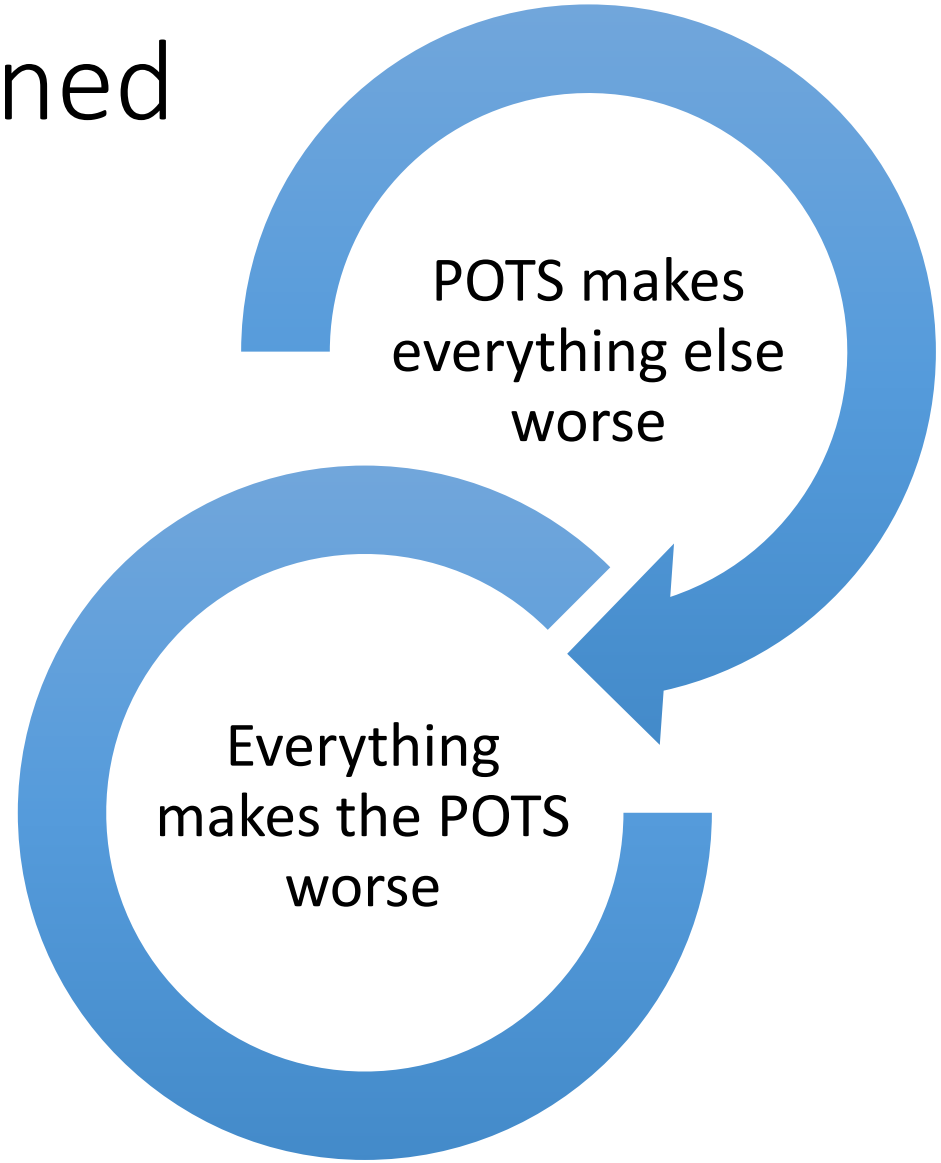


Lessons Learned



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Epidemiology of POTS

Postural Orthostatic Tachycardia Syndrome

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- Prevalence is between 0.2% and 1.0% in US population totaling approximately 500,000 patients (Fedorowski, 2019)
- Mostly White, predominantly female
  5: 1 ratio F: M
- Strikes in adolescence to early adulthood
- Origins in Civil War medicine “Soldier’s Heart” or irritable heart
- 1993: POTS coined by Mayo MDs
- “Otherwise healthy until they are not”
- 2X in JAT
- 1 additional published case study of athletes with POTS


The Invisible Illness: POTS takes a toll on students’ academic, social lives

Photo courtesy of Caroline Muir

Junior Caroline Muir smiles before an endosscopy and a liver biopsy at Georgetown University Hospital this summer. Muir has POTS, and has had several procedures to manage her symptoms.

Herrnstadt, D. (n.d.). The Invisible Illness: POTS takes a toll on students’ academic, social lives. *The Black and White*. Retrieved June 8, 2022, from https://theblackandwhite.net/62070/feature/the-invisible-illness-pots-takes-a-toll-on-students-academic-social-lives/

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“I was a happy and healthy teenager until one day, at age 13, I woke up not feeling well. Every time I stood up I felt lightheaded. I also had joint pain and terrible stomach pain, especially when I would eat. I was told I had Lyme and I'd be fine after I took the normal course of antibiotics. It only got worse from there. Suddenly, I went from being a volleyball player with great grades to barely being able to get out of bed. I saw 10 doctors over the next few years trying to figure out what was wrong. I was told I had an eating disorder. I didn't. I was told I was just anxious. I wasn't. Doctors gave me numerous medications to try. Nothing worked. Some doctors gave up on me. I began to feel hopeless” (Stiles et al., 2018).

Etiology of POTS

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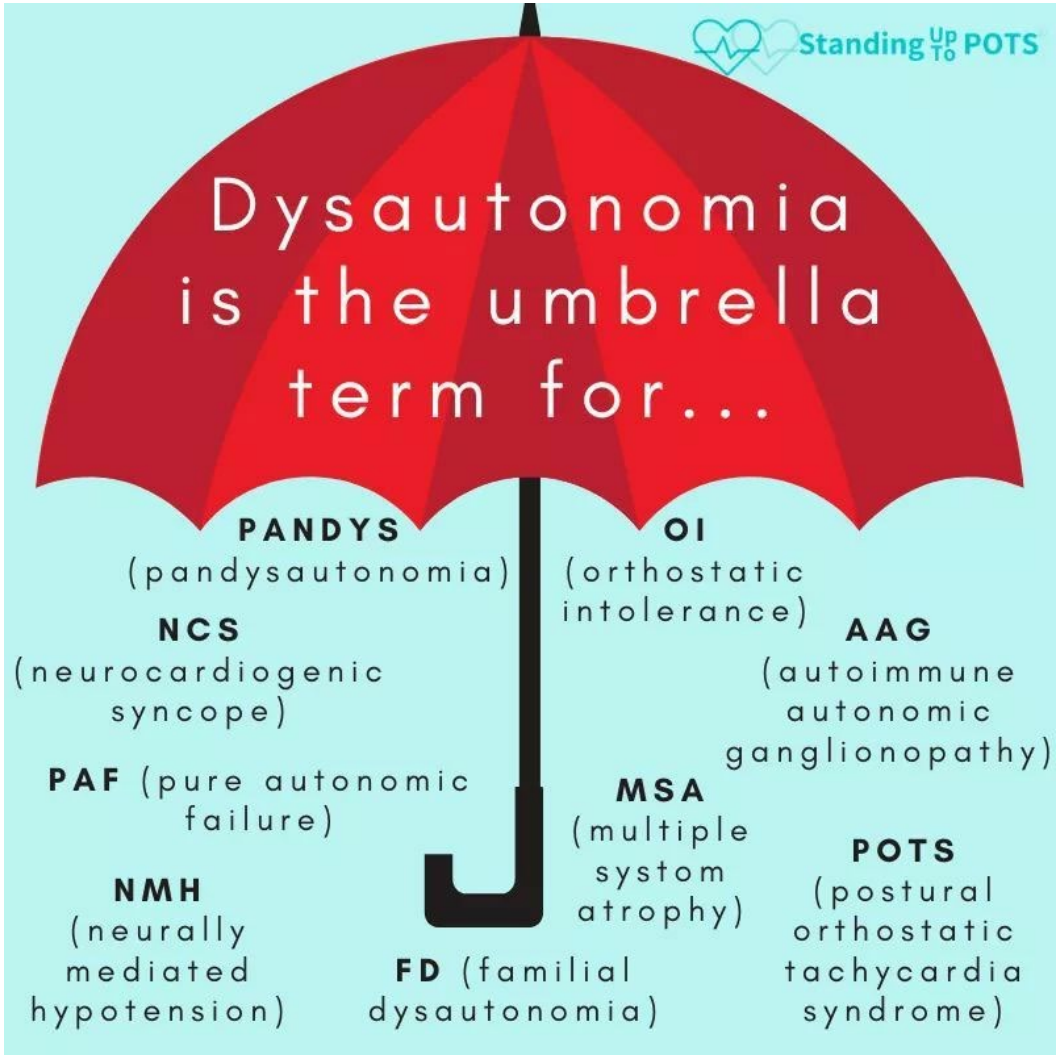
Dysautonomia Family

DYSAUTONOMIA INTERNATIONAL

AWARENESS ADVOCACY ADVANCEMENT



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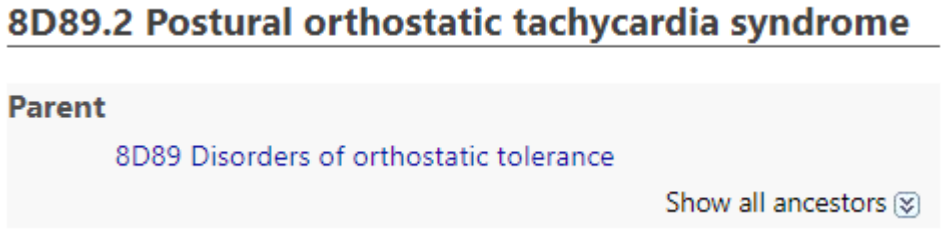
https://www.standinguptopots.org/resources/cheat-sheet

Postural Orthostatic Tachycardia Syndrome (POTS)



- Abnormal autonomic response to positional changes resulting in dizziness, lightheadedness, syncope, blurring or fading vision, weakness, fatigue, palpitations, mental clouding, anxiety, dyspnea, or headache.
- Sx last >6 (or >3) months
- Key diagnostic criteria: an increase in HR exceeding 40 bpm (or a rate that exceeds 120 bpm) within 10 min of standing. (>30 BPM change for ICD-11)
  - Must be in absence of sustained orthostatic hypotension.

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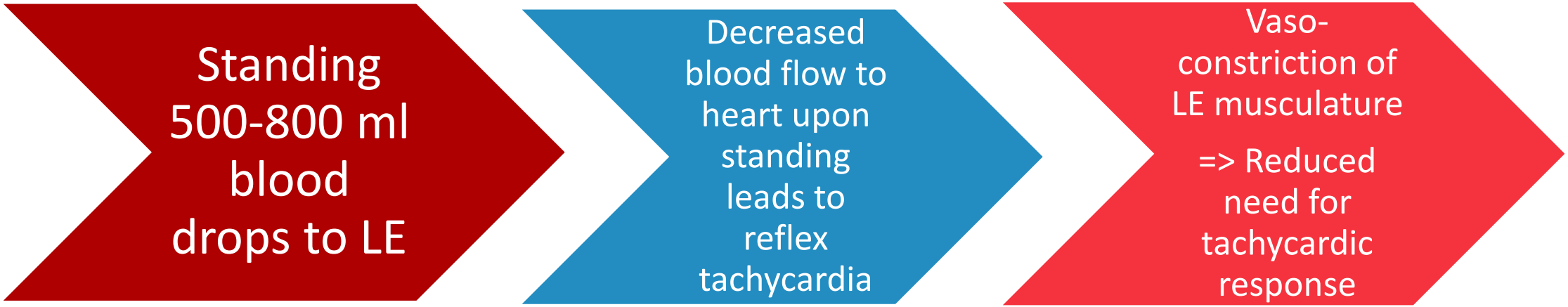
Normal Autonomic Nervous System Response to Postural Changes



In POTS patients, peripheral tone in smooth and skeletal mm is altered, leading to venous pooling in LE->reflex tachycardia persists beyond normal response

Hyper adrenergic response

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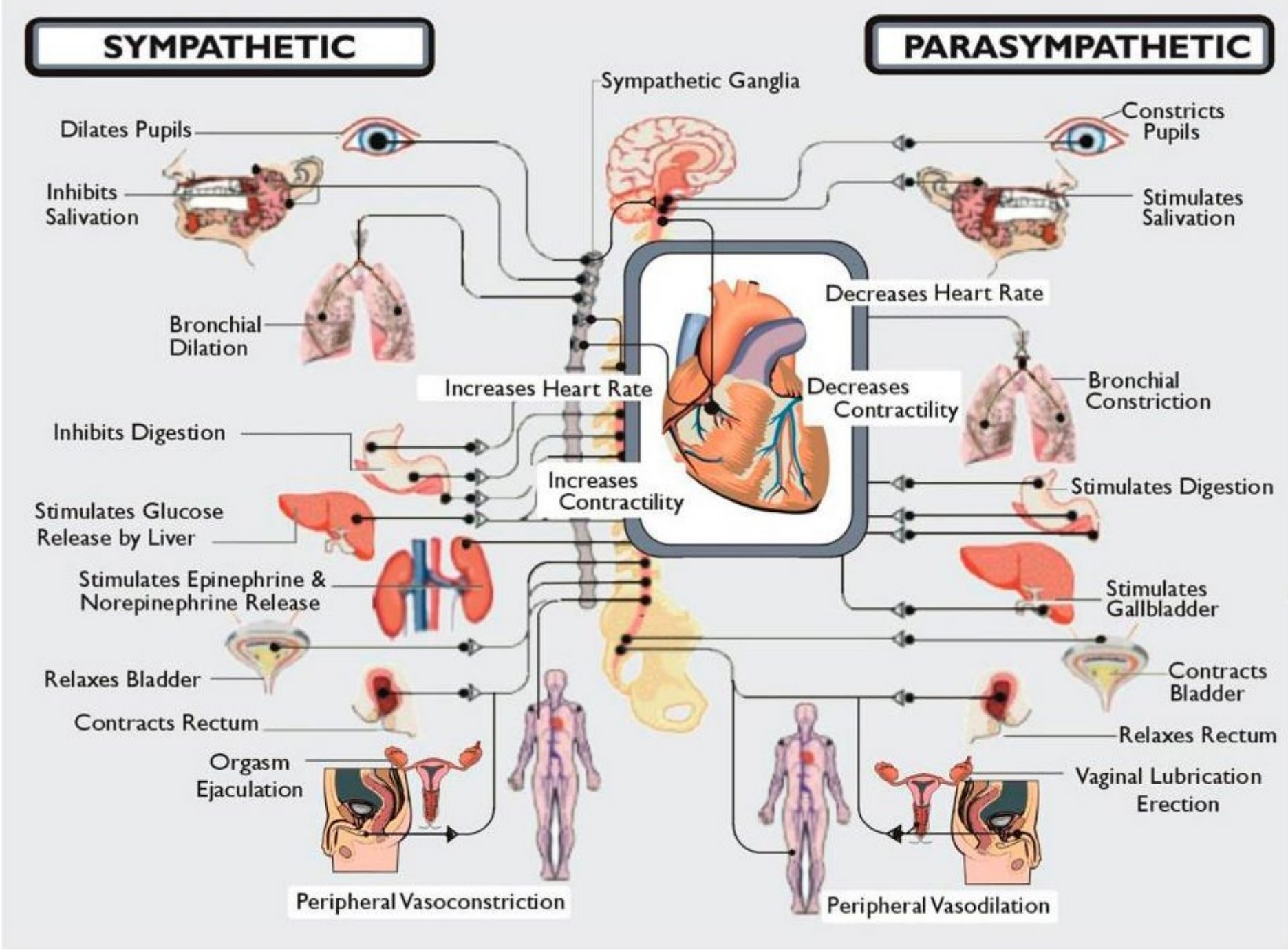

http://www.dysautonomiainternational.org/page.php?ID=122

Additional POTS Symptoms

- Lightheadedness
- Palpitation (“heart racing”)
- Tremulousness
- Atypical chest discomfort
- Sleep disturbances
- Headaches
- Chronic fatigue
- Chronic pain
- Exercise intolerance and deconditioning
- Perceived cognitive impairment (“brain fog”)
- Peripheral acrocyanosis (“POTS feet”)
- Frequent nausea
- Mild diarrhea/constipation/bloating/unspecific abdominal pain (“irritable bowel syndrome”)

(Raj et al., 2020)

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Causes of POTS

- Idiopathic
- Autoimmune Process
- Genetic Theory
- Antecedent Viral Illness
- Concussion
- Significant Stressor

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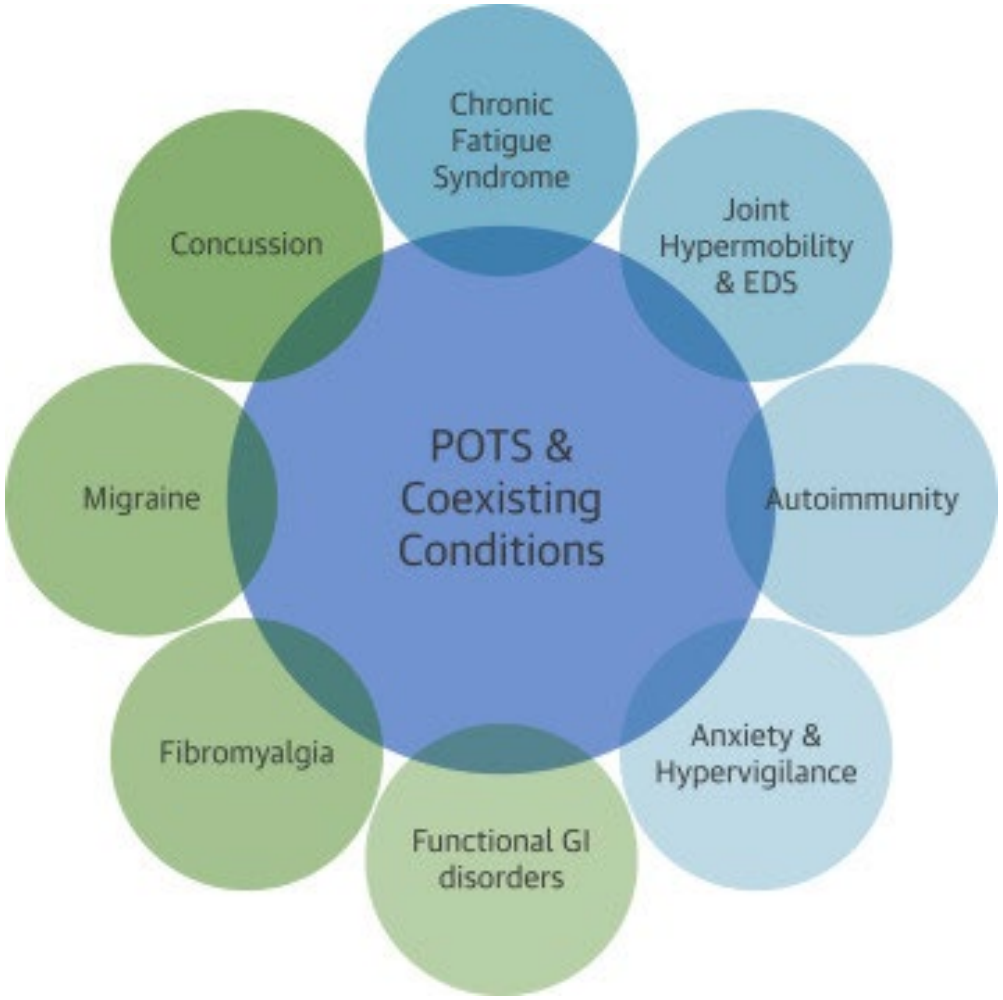
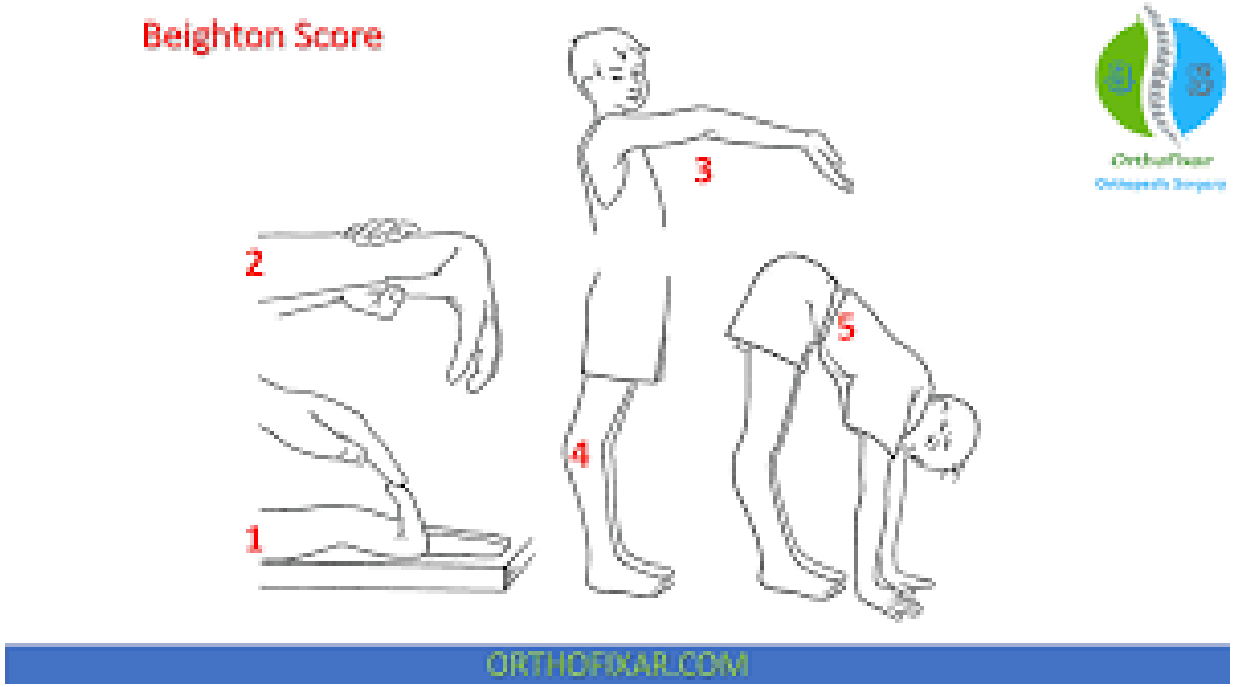
Common Comorbidities



Bryarly et al., 2019



https://orthofixar.com/special-test/beighton-score/

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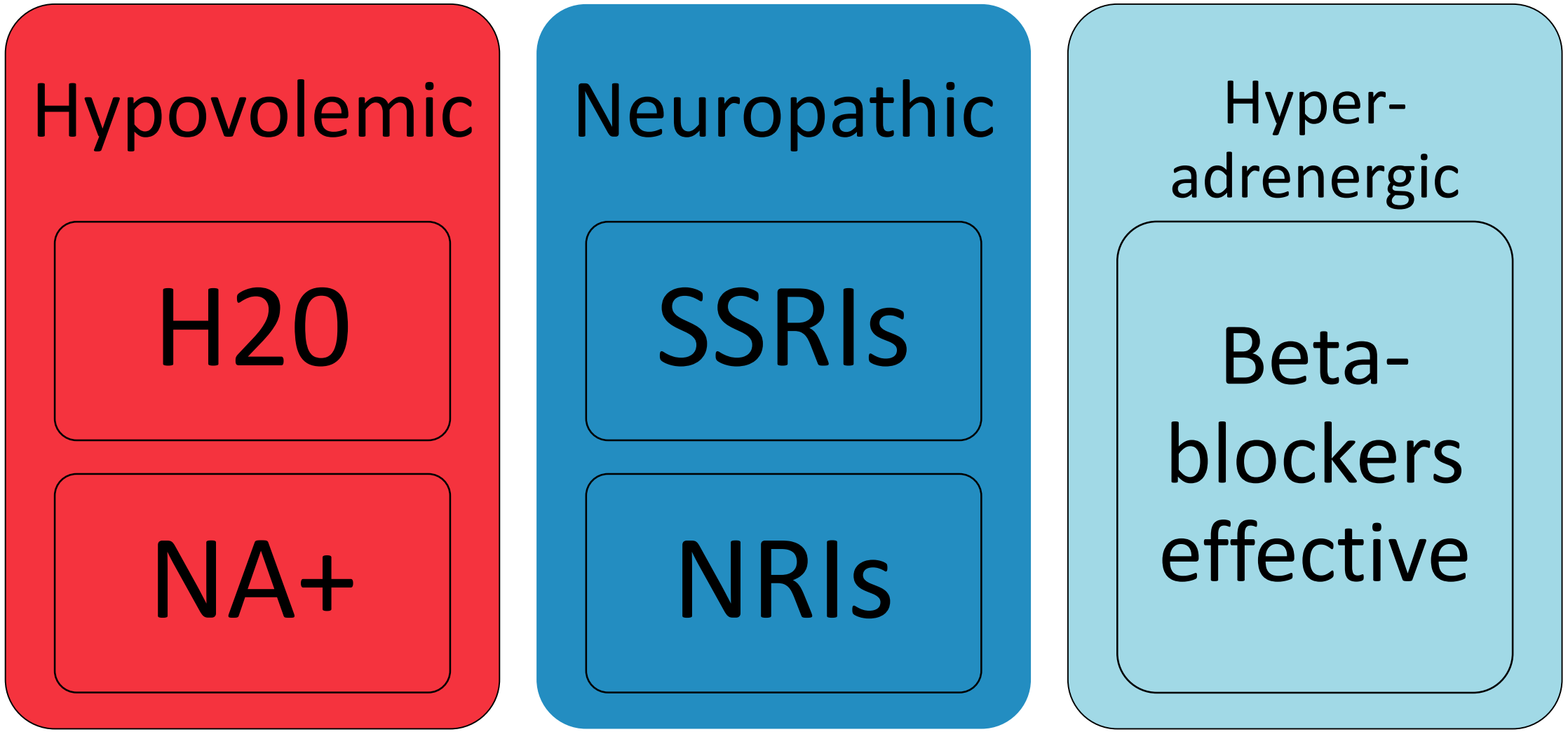
POTS Sub-types and Treatment Strategies



Diagnosing POTS

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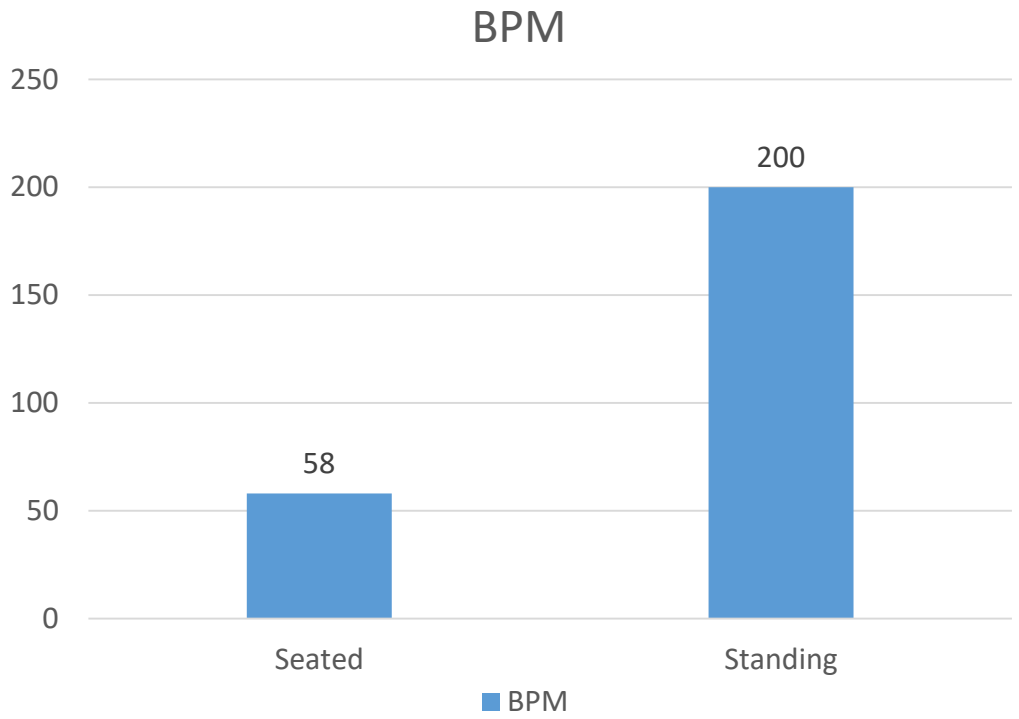
Molly: Diagnosis

- Fall 2021: Presented to GP/Family Medicine Specialist highlighting syncopal or near syncopal events
- MD asked pt to change position in office from sitting to standing.
- Diagnosed with POTS and referred to cardiologist.



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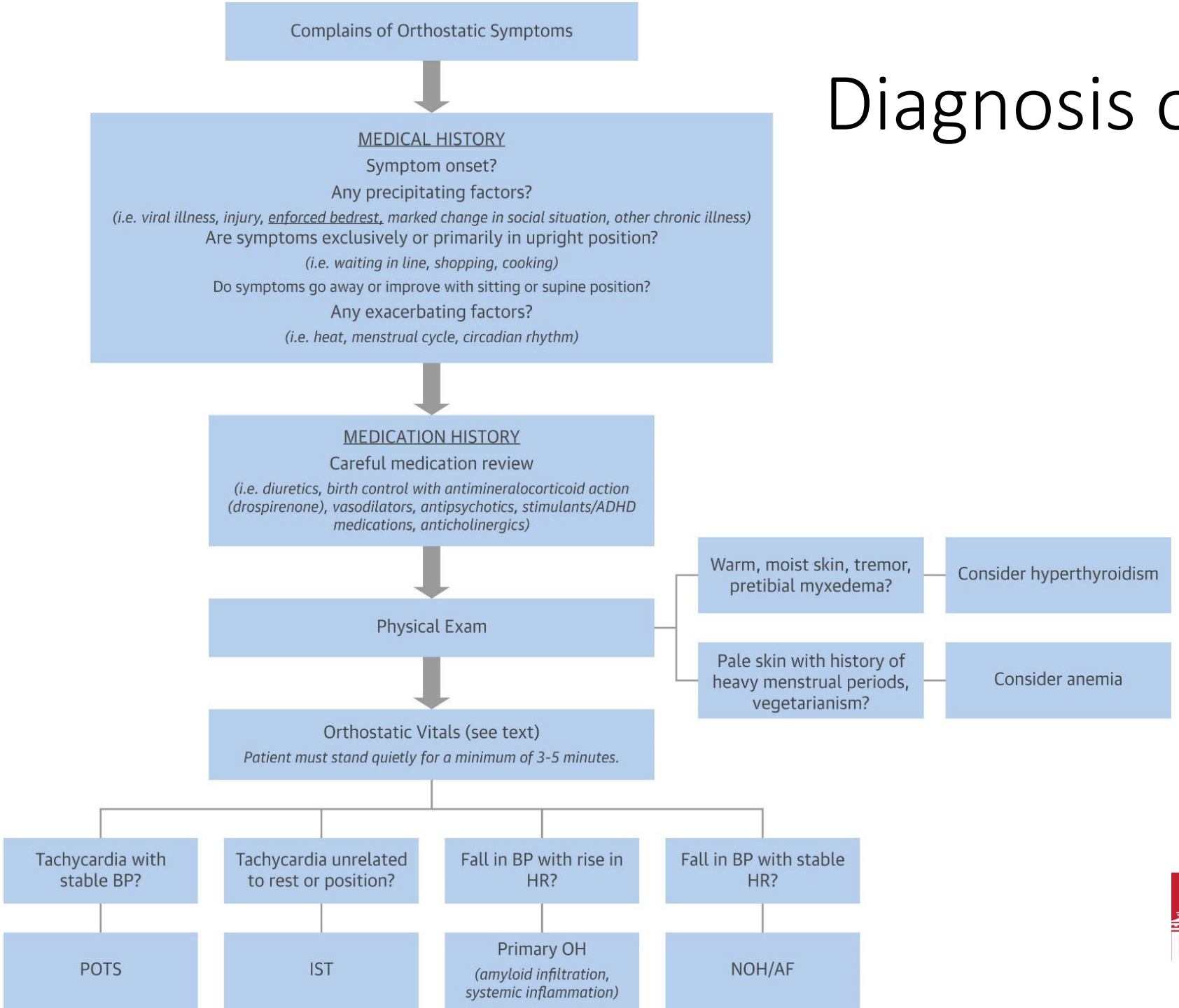
Diagnosis of POTS



Bryarly, M., Phillips, L. T., Fu, Q., Vernino, S., & Levine, B. D. (2019). Postural Orthostatic Tachycardia Syndrome: JACC Focus Seminar. *Journal of the American College of Cardiology*, *73*(10), 1207–1228. https://doi.org/10.1016/j.jacc.2018.11.059

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Diagnostic Testing for POTS

Clin Sci (Lond). Author manuscript; available in PMC 2014 Jan 1.
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Clin Sci (Lond). 2013 Jan 1; 124(2): 109–114.
doi: 10.1042/CS20120276

PMCID: PMC3478101
NIHMSID: NIHMS410519
PMID: 22931296

Diagnosing Postural Tachycardia Syndrome: Comparison of Tilt Test versus Standing Hemodynamics

Walker B Plash, BS,[1] André Diedrich, MD, PhD,[1,2,3,4] Italo Biaggioni, MD,[1,2,3,5] Emily M Garland, PhD, MSCI,[1,2,3] Sachin Y Paranjape, BS,[1,2,3] Bonnie K Black, RN, CNP,[1,2,3] William D Dupont, PhD,[1,6] and Satish R Raj, MD, MSCI[1,2,3,5]

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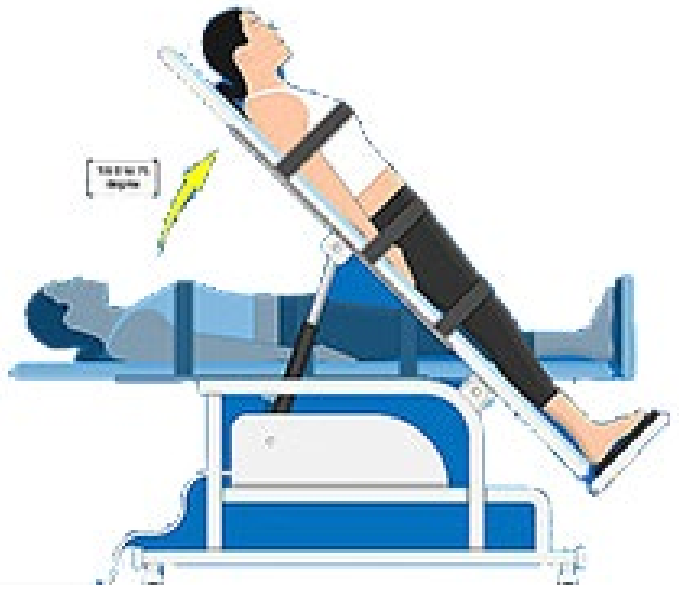
Optimal ΔHR cutoffs for diagnosis of POTS

	10 min stand	10 min tilt	30 min stand	30 min tilt
ΔHR	29	37.6	34	47
Sn	93%	80%	93%	87%
Sp	67%	73%	67%	80%



Tilt Table Testing

Canberra Heart Rhythm Centre—Tilt testing. (n.d.). Retrieved June 10, 2022, from https://www.canberraheartrhythm.com.au/services/procedures/17-services/23-tilt-testing.html

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Quantitative Sudomotor Axon Reflex Test (QSART)

POTS Testing | Standing Up To POTS. (n.d.). Retrieved June 10, 2022, from https://www.standinguptopots.org/resources/diagnosing-pots

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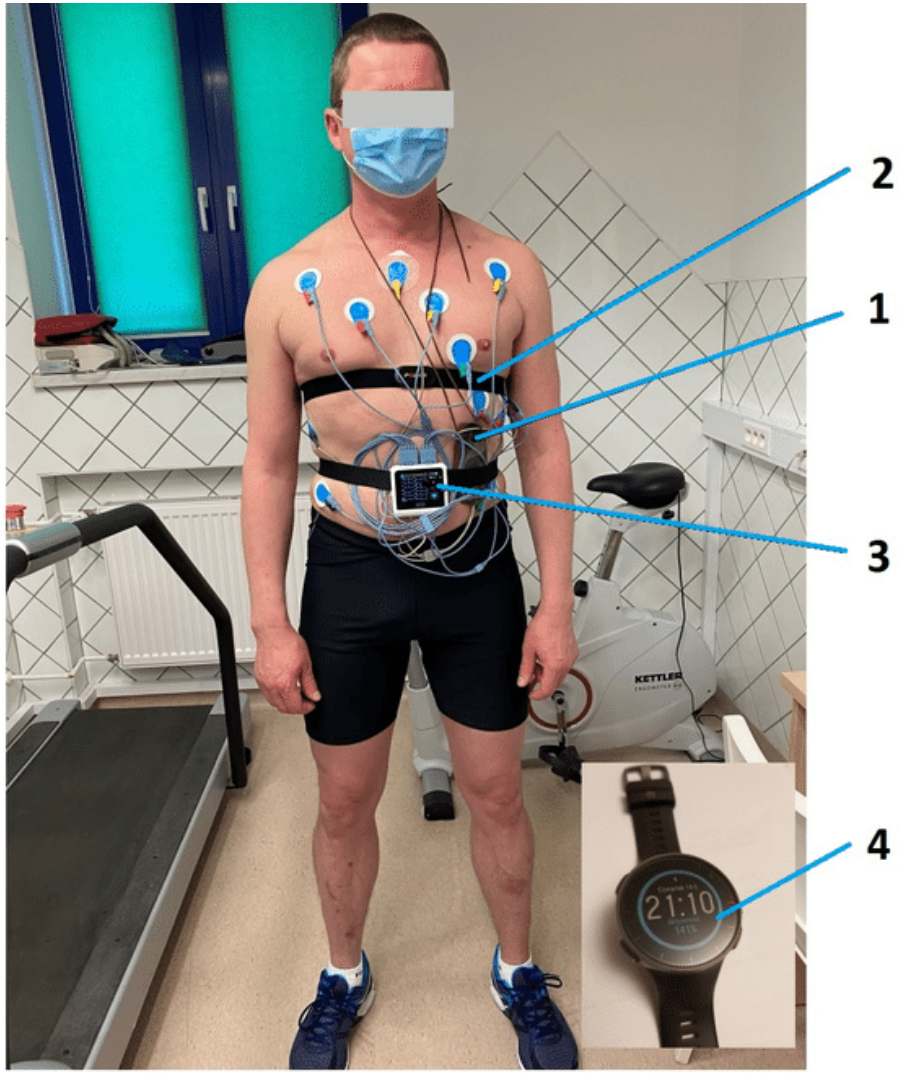
Other Tests

- Valsalva Maneuver
- CBC/TSH
- Echocardiogram
- ECG/Holter Monitor
- Blood Volume Assessment
  - Low BV->low venous return

  ->reflex tachycardia->orthostatic intolerance
- Exercise Capacity



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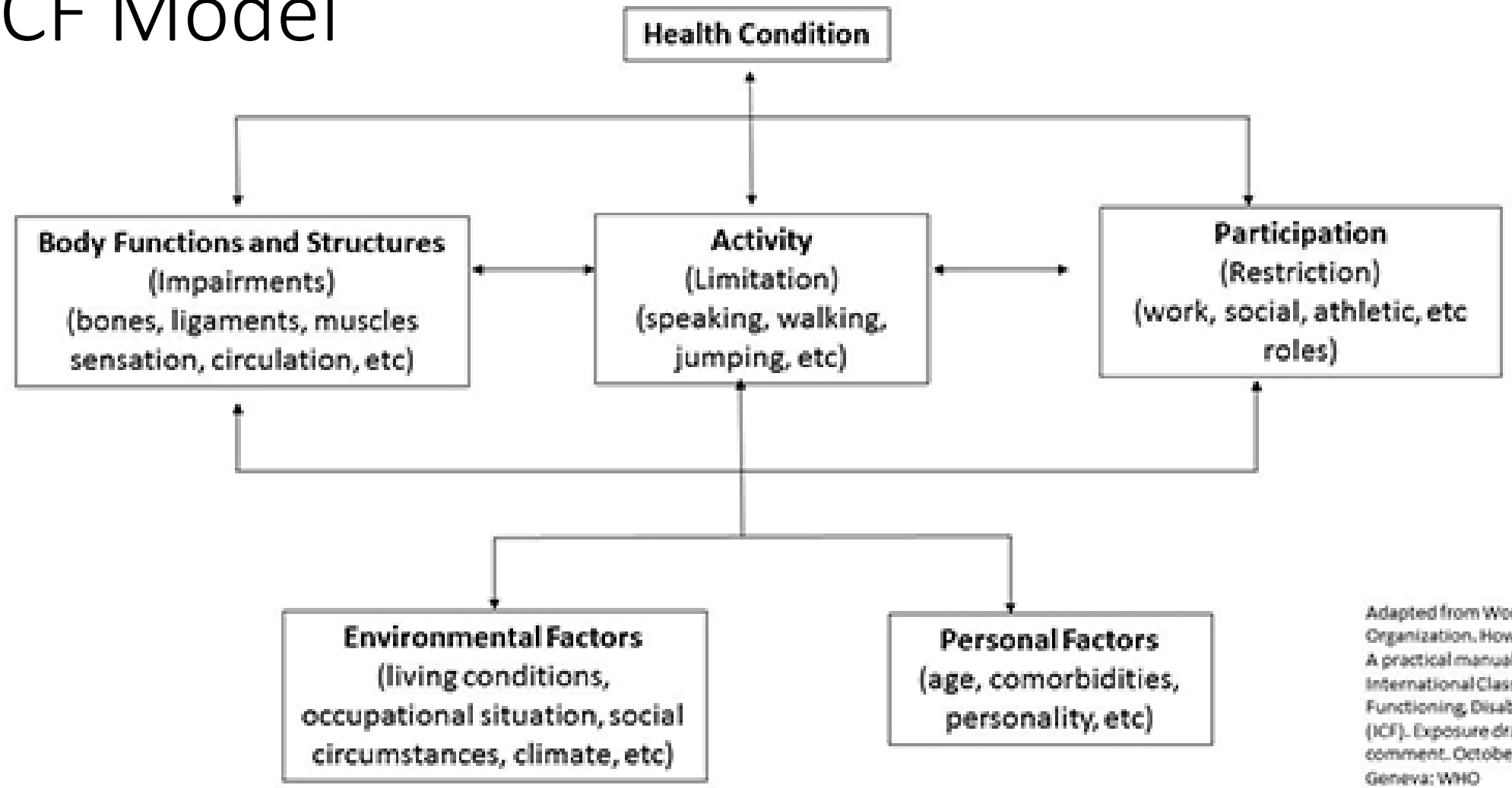
ICF Model



Adapted from World He
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A practical manual for u
International Classificati
Functioning, Disability a
(ICF). Exposure draft for
comment. October 2013
Geneva: WHO

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Molly's Case Disablement Model

Health Condition

Postural Orthostatic Tachycardia Syndrome

Body Function & Structures

- Tachycardia
- Headache
- Nausea and vomiting
- Brain fog
- Severe fatigue
- Lightheadedness/dizziness
- UTIs

Activities

- Dressing/bathing/self-care
- Sleeping disruptions
- Sit to stand syncope
- Eating/feeding disrupted
- Walking >20 feet
- Standing > 1m

Participation

- Often can't attend school due to sx
- Can't safely participate in swim practice/comps and water polo px/ games
- Can't engage in social activities
- Struggled academically because of brain fog/absences

Environmental Factors

- Illness onset at beginning of school year following COVID-19 restriction; swim season
- Has a highly educated and supportive family
- Both parents work full-time; mom=teacher
- Good healthcare coverage
- Is an older sister to one female sibling

Personal Factors

- Female
- 16 years old
- Allergic to multiple antibiotics
- Feels like she let her swim team down
- Taking SAT 21-22 AY
- Upset that she's lost the life she used to have
- Experiencing reduced social life due to sx

Effect on Athletic Life of Molly

Season 2021-2022

USA Club (15 - 18)

Maverick Swim Club
16th • 437.85 pts

USA High School

Dupage Valley Conference
71st • 378.31 pts

Metea Valley High School
11th • 378.31 pts

Season 2020-2021

USA Club (Open)

Maverick Swim Club
10th • 486.65 pts

USA Club (15 - 18)

Fox Valley Regional
95th • 525.00 pts

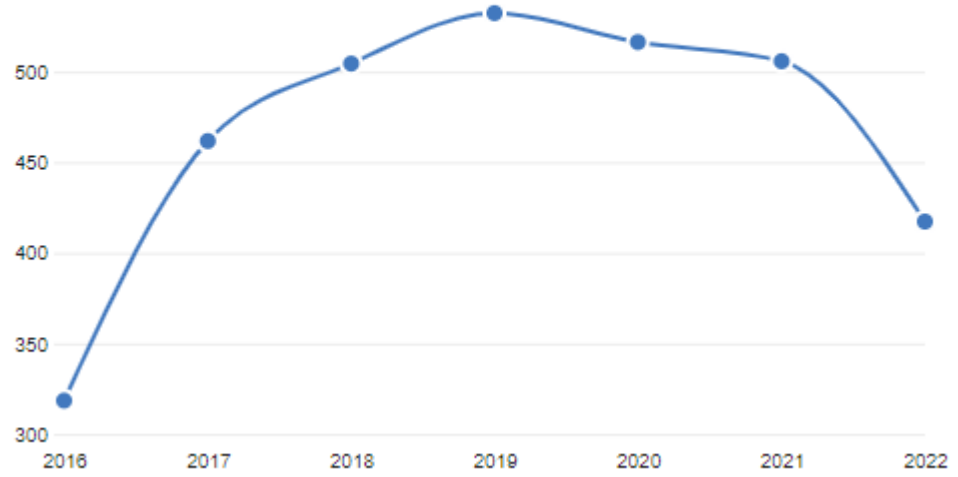
Maverick Swim Club
7th • 525.00 pts

USA High School

Dupage Valley Conference
66th • 458.30 pts

Metea Valley High School
9th • 458.30 pts

Progression



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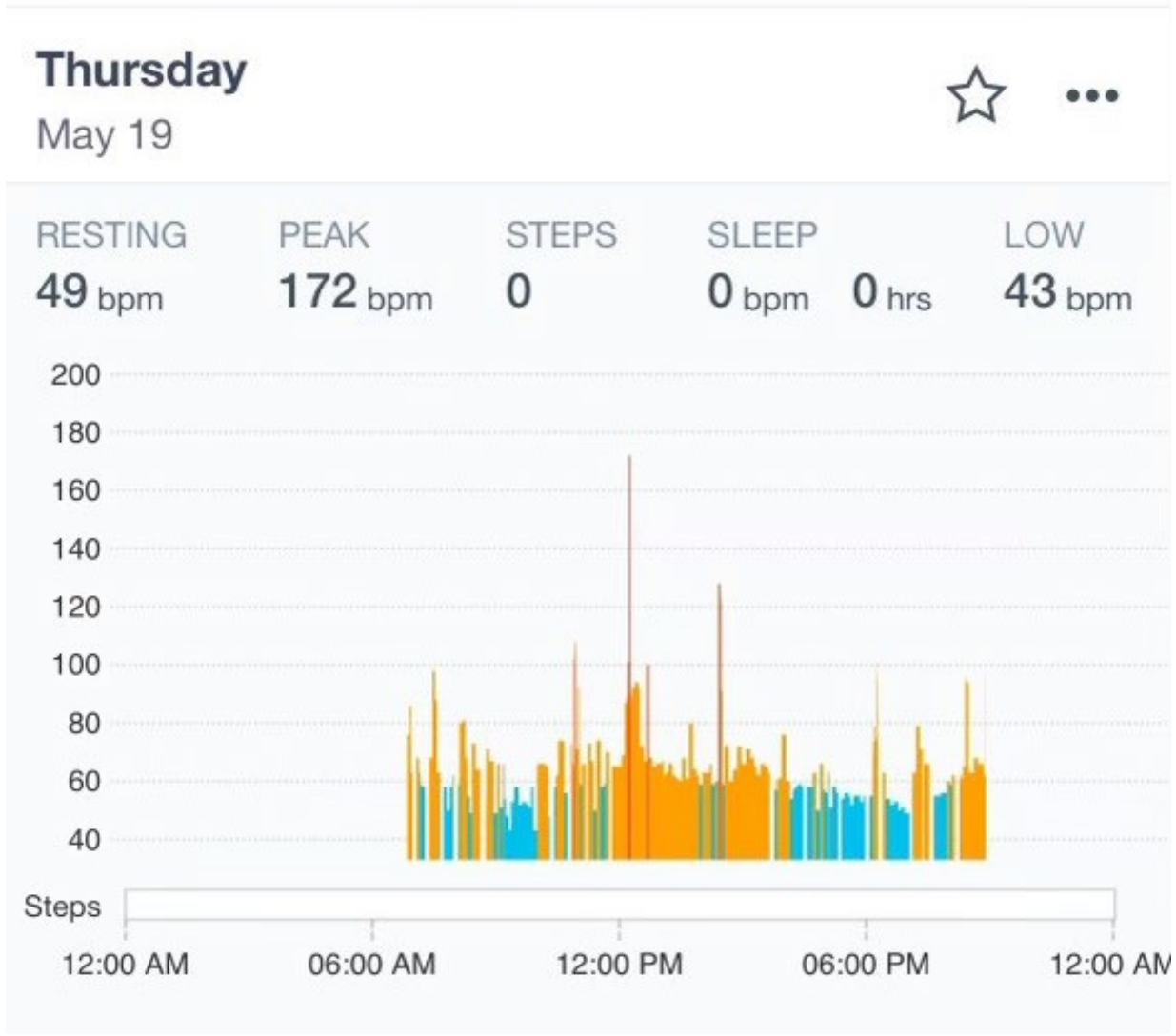

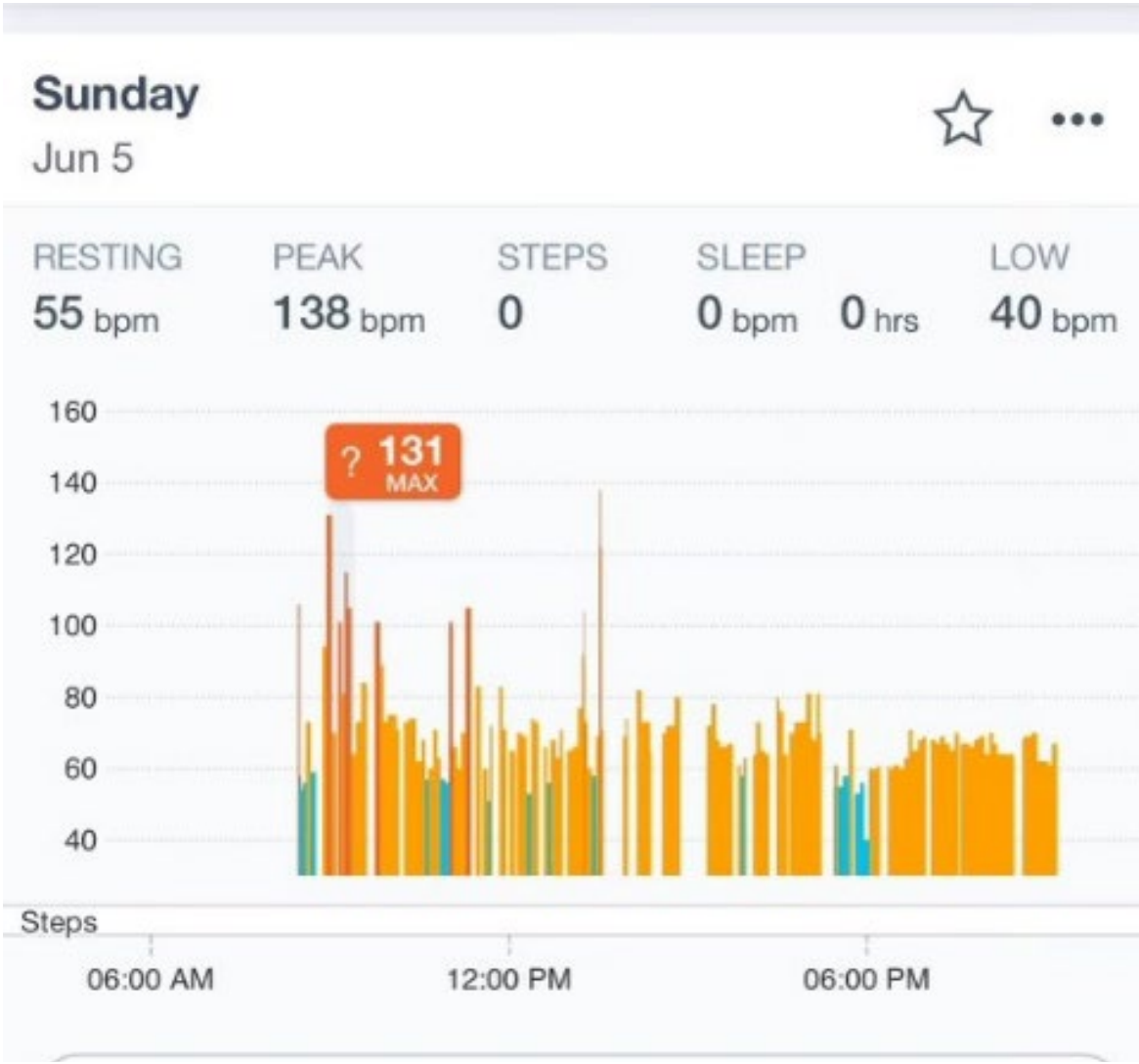

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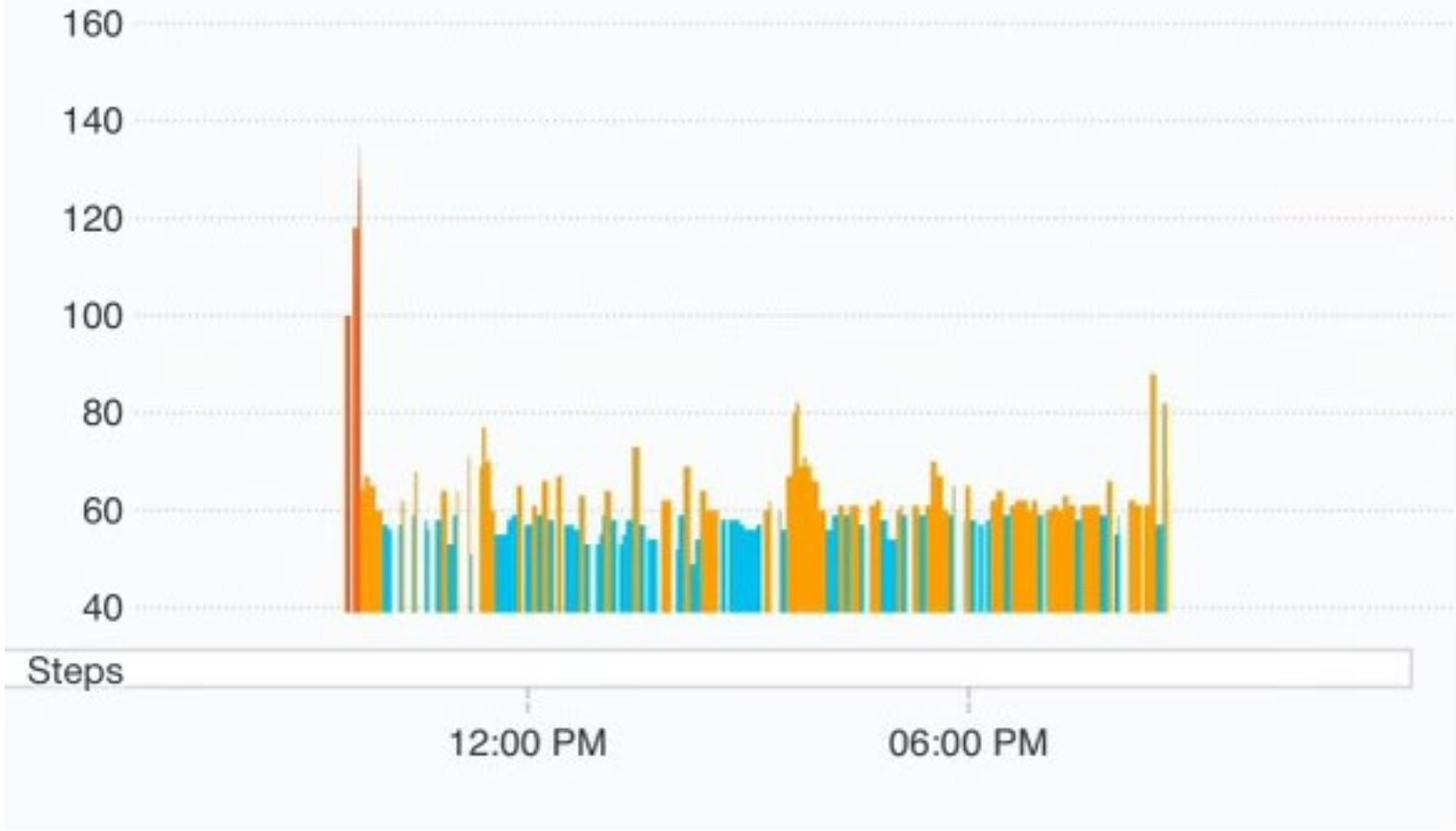
Monday

Jun 6

RESTING	PEAK	STEPS	SLEEP		LOW
53 bpm	135 bpm	0	0 bpm	0 hrs	49 bpm



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Effect on Academic Life of Molly

- >30 days absent from school in 21-22
- 504 plan to allow for freely accessible water and bathroom breaks; late assignments due to fatigue, inability to attend school
- SAT review class due to missed classes and academic absences

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Management of POTS

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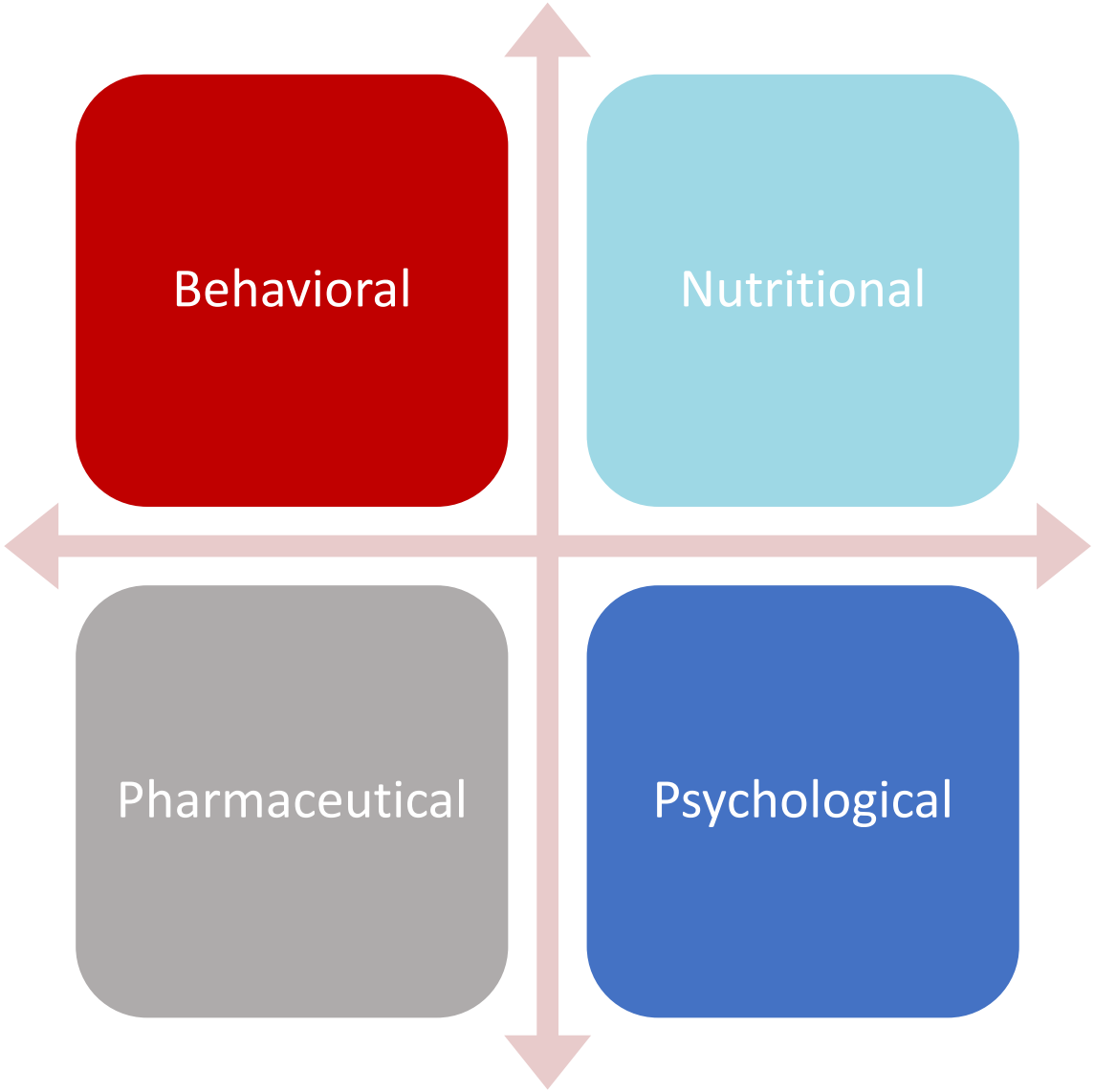
Management of POTS



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Care Team

- Neurology
- Cardiology
- POTS multispecialty clinic

Shirley Ryan Abilitylab

Ann & Robert H. Lurie Children's Hospital of Chicago

MAYO CLINIC

NorthShore University HealthSystem

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Nutritional Strategies

1) H20: fluids intake of 2-2.5L/day

- NATA recommendations 7-10 oz. q 10-20” during ex
- Athletes can lose 2-3% BW in water in 2 hour practice; especially triggering for POTS patients.
- Heat acclimatization leads to lower NA+ losses in sweat; more dilute sweat
  - Important to POTS patients

- Avoid diuretics: caffeine, alcohol (also vasodilator)
- Improving iron can increase BV

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Nutritional Strategies

2) Sodium

- Athletes are naturally challenged due to NA+ losses in sweat
  - Salty sweaters
- 3-5 gm/day
- Salty snacks: avoid high fat/cal
- Electrolyte sticks, medilytes, pedialytes
- Liquid IV
  - Avoid salt tablets to avoid gut issues
- Saline infusions for acute attacks

Pharmaceutical Strategies

- Early care was antihistamines
- Beta blockers: slows HR
  - banned substance for some
  - Propranolol
  - Medroprolol
- SSRIs
- NRIs
- Cortisone: increases blood volume
  - fludrocortisone
- Supplements: Melatonin can help with sleep

Behavioral Strategies

1)Exercise
- Lower Extremity
- Avoid Valsalva (Arnold et al., 2013)
- Levine/CHOPS protocol
- Spotting for WB Ex
- Avoiding ex after large meals

2) Compression garments
- 20-30 mmHg, to abdomen
- Especially in heat

BlogAdmin. (n.d.). *The Skinny On Compression Stockings | The Dysautonomia Dispatch*. Retrieved June 10, 2022, from https://dysautonomiainternational.org/blog/wordpress/the-skinny-on-compression-stockings/

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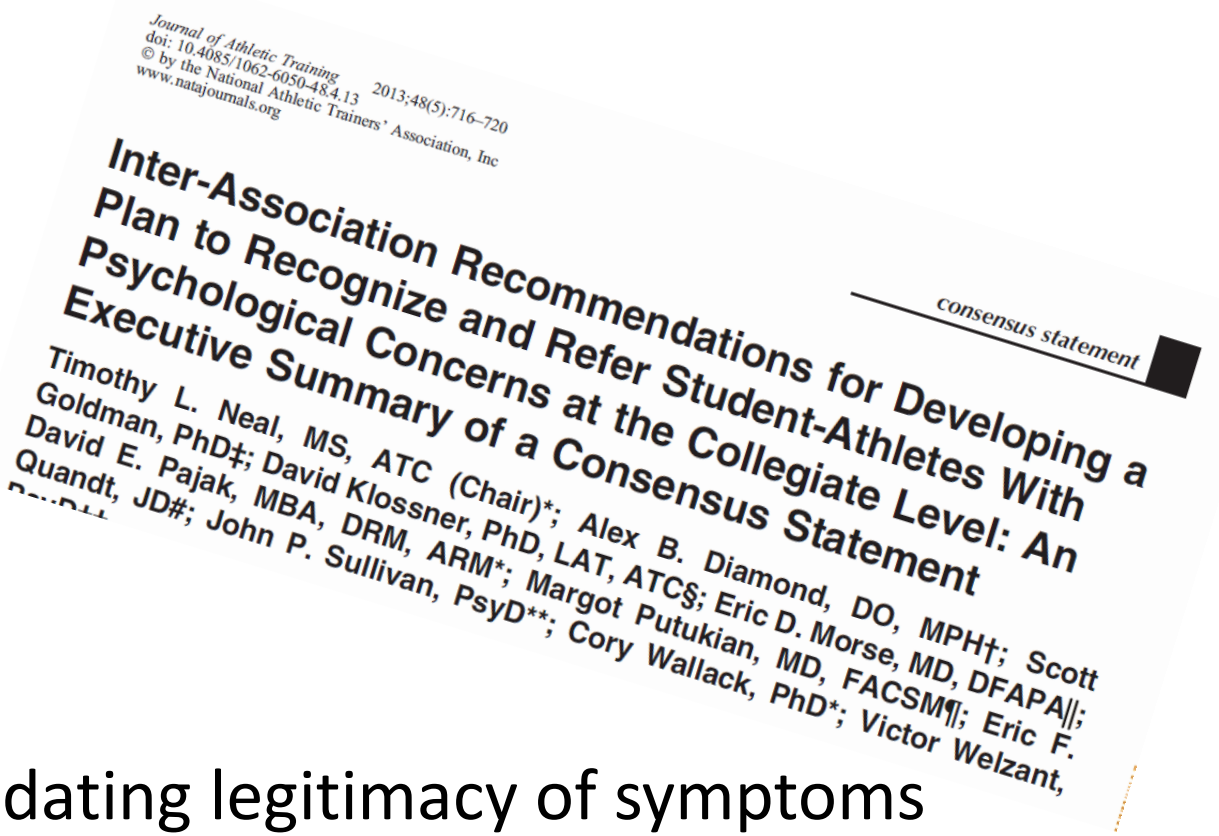
Psychological



Journal of Athletic Training 2013;48(5):716–720
doi: 10.4085/1062-6050-48.4.13
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consensus statement

Inter-Association Recommendations for Developing a Plan to Recognize and Refer Student-Athletes With Psychological Concerns at the Collegiate Level: An Executive Summary of a Consensus Statement

Timothy L. Neal, MS, ATC (Chair)*; Alex B. Diamond, DO, MPH†; Scott Goldman, PhD‡; David Klossner, PhD, LAT, ATC§; Eric D. Morse, MD, DFAPA‖; David E. Pajak, MBA, DRM, ARM*; Margot Putukian, MD, FACSM¶; Eric F. Quandt, JD#; John P. Sullivan, PsyD**; Cory Wallack, PhD*; Victor Welzant,

- Anxiety/Depression/Suicidality
- AT can provide support through validating legitimacy of symptoms
- Recognizing the loss of opportunity
- Advocacy for patient by AT
- Seeking care from a MH professional who specializes

in chronic disease management

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Patient Outcomes

- Dysautonomia scales available; no POTS specific outcomes scale located
- SF-36 often used
- Quality of life is similar to those with COPD and CHF when using SF-36
- 25% of POTS patients are disabled and unable to work (Benrud-Larson et al., 2002)
- FUSS scale
- SCOPA-AUT
- Ewing Battery
- RAND-36
- COMPASS-31

The following questions are about activities you might do during a typical day. In the past 1-week does your health limit you in these activities? If so, how much?

(Please circle one number on each line)

	ACTIVITIES	Yes Limited A lot	Yes Limited A little	No, Not Limited At All
3a:	Vigorous activities, such as running, lifting heavy Objects, participating in strenuous sports	1	2	3
3b:	Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	1	2	3
3c:	Lifting or carrying groceries	1	2	3
3d:	Climbing several flights of stairs	1	2	3
3e:	Climbing one flight of stairs	1	2	3
3f:	Bending, kneeling, or stooping	1	2	3
3g:	Walking more than one kilometre	1	2	3
3h:	Walking half a kilometre	1	2	3
3i:	Walking 100 metres	1	2	3
3g ww:	Wheeling more than one kilometre	1	2	3
3h ww:	Wheeling half a kilometre	1	2	3
3i ww:	Wheeling 100 metres	1	2	3
3j:	Bathing or dressing yourself	1	2	3

[a]Modified from SF-36[1]: Items 3 (a to j) are the original SF-36 questions, while 3g ww to 3i ww (shaded area) comprise the supplementary SF-36ww modification.

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VOSS

- Vanderbilt Orthostatic Symptom Scale
- 9 orthostatic symptoms rated on a scale of 0 (no symptom) to 10 (worst the participant has experienced)

Mental clouding	Blurred vision	Shortness of breath
Rapid Heart Rate	Tremulousness	Chest Discomfort
Headache	Lightheadedness	Nausea

- The maximum score a participant can receive is 90 arbitrary units (AU), and a higher score is indicative of a greater orthostatic symptom burden (Bourne et al., 2021)

Patient Outcomes

- Survey of over 500 adolescent POTS patients (n=172); mean age 21.6 (2.2) avg of 5 years post-diagnosis.
- 19% of respondents reported complete resolution of symptoms
- Additional 51% reported persistent but improved symptoms
- 16% had only intermittent symptoms
- 71% considered their health at least “good.”
- 86% of adolescents with POTS report resolved, improved, or just intermittent symptoms at an average of 5 years after initial treatment

(Bhatia et al., 2016)

In summary…

- Heterogenous presentation of POTS causes diagnostic and management challenges for athletes
- Athletic trainers can be important in assisting patients in getting accurate diagnosis early through careful history and referral
- Athletic trainers serve an important role in assisting with the management of POTS patients so they can return to or continue to pursue physical activity for sport, health, and personal enjoyment

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Thank you!

Questions?

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