# Pediatric Long COVID

Laura A. Malone MD PhD

Co-Director, Pediatric Post COVID-19 Rehabilitation Clinic

Dept of Neurology and Physical Medicine and Rehabilitation, Johns Hopkins



# **Background of COVID-19**

As of May 2023<sup>3</sup>:

Ē

- 15.6 million pediatric cases in United States
  - 1-15 in 1000 pediatric cases hospitalized
  - As many as 2 in 10,000 deaths in pediatric cases



### **Considerations of Pediatric Long COVID**



- Acute COVID-19 infections may be mild or asymptomatic:
  - Lack of testing in many pediatric patients
  - Limited knowledge that children can experience long COVID





# **Long COVID in Pediatrics**

#### **Prevalence estimates:**

#### individual studies: 4-66%

First author	Country	Study	Age (y) <sup>a</sup>	Timing	g Cases	Controls	Prevalence of patients with persisting symptoms
Blankenburg	Germany	CS	median 15 (14-16)	nr	nr	nr	nr Studies with controls
Miller	UK	PCS	nr, ≤17	4w	8/174	72/4504	5% p=0.009
Molteni	UK	PCS	median 13 (10-15)	4w	77/1734	15/1734	4% p=0.0001
				8w	25/1734	nr	2%
Radtke	Switzerland	PCS	median 11 (nr)	4w	10/109	121/1246	9% p=0.9
				12w	4/109	28/1246	4% p=0.3 2% p≤0.0001
Stephenson	UK	PCS	range 11-17	12w	2038/3065	1993/3739	66%
Ashkenazi-Hoffnung	Israel	PCS	mean 12 (5)	b	90	-	nr Studies without controls
Blomberg	Norway	PCS	median 8 (6-12)	5m	2/16	-	13%
Brackel	Netherlands	CS	median 13 (9-15)	nr	89	-	nr
Buonsenso	UK, USA	CS	mean 10 (3.8)	4w	510	-	nr
Buonsenso	Italy	CS	mean 11 (4.4)	с	75/129	•	58%
Osmanov	Russia	PCS	median 10 (3-15)	5m	126/518	-	24%
Say	Australia	PCS	mean 3.7 (3.5)	4w	12/151	-	8%
				12w	0/151	-	0%
Smane	Latvia	RCS	mean 9.2 (5.2)	d	9/30	-	30%
Sterky	Sweden	PCS	nr, ≤18	16w	12/55	-	22%
<ul> <li>mean (SD), median (int b median 112d after infect c mean 163d after infecti d mean 101d after infecti</li> </ul>	erquartile range) ction, range 33–4 on, SD 114d on, SD 17d	), or range 10d	;				0 10 20 30 40 50 60 70 8

CS, cross-sectional study; d, days; m, month; nr, not reported; PCS, prospective cohort study; RCS, retrospective cohort study; SD, standard deviation; w, weeks; y, years

#### Zimmerman et al. 2021

#### larger estimates: 5-25%



#### Lopez-Leon et al. 2022

# Patient symptoms: KKI Cohort



### **Limited Pediatric Long COVID Clinics**

- 14 pediatric COVID clinics in the US
  - Some focus on follow-up of hospitalized or MIS-C patients only
  - Many children rely on pediatricians only for healthcare services



About Us  $\sim$  Long Covid  $\sim$  Healthcare  $\sim$  Daily Living  $\sim$  Advocacy  $\sim$  Blog Donate Q

#### Pediatric Covid Clinics





### **2022 PASC Pediatric Guidance Statement**

- Members
  - Cardiology
  - Gastroenterology
  - General Pediatrics
  - Infectious disease
  - Neurology
  - Neuropsychology
  - Otolaryngology
  - Patient Representative
  - Pediatric Rehabilitation Medicine
  - Psychiatry
  - Psychology
  - Pulmonology

- States
  - Colorado
  - Maryland
  - Massachusetts
  - New Jersey
  - New York
  - Oregon
  - Pennsylvania
  - Texas



### WILEY

#### Clinical Guidance 🛛 🔂 Free Access

Multi-disciplinary collaborative consensus guidance statement on the assessment and treatment of postacute sequelae of SARS-CoV-2 infection (PASC) in children and adolescents

Laura A. Malone MD, PhD, Amanda Morrow MD, Yuxi Chen MD, Donna Curtis MD, MPH, Sarah D. de Ferranti MD, MPH, Monika Desai MD, Talya K. Fleming MD, Therese M. Giglia MD, FAHA, Trevor A. Hall PsyD, ABPdN, Ellen Henning PhD, Sneha Jadhav MD, Alicia M. Johnston MD, Dona Rani C. Kathirithamby MD, Christina Kokorelis MD, Catherine Lachenauer MD, Lilun Li MD, Henry C. Lin MD, Tran Locke MD, Carol MacArthur MD, Michelle Mann MD, Sharon A. McGrath-Morrow MD, Rowena Ng PhD, Laurie Ohlms MD, Sarah Risen MD, S. Christy Sadreameli MD, MHS, Sarah Sampsel MPH 💽, S. Kristen Sexson Tejtel MD, PhD, MPH, Julie K. Silver MD, Tregony Simoneau MD, Rasha Srouji DNP, Sanjeev Swami MD, Souraya Torbey MD, Monica Verduzco Gutierrez MD, Cydni Nicole Williams MD, MCR, Lori Allison Zimmerman M.D., Louise Elaine Vaz MD, MPH ... See fewer authors

First published: 28 September 2022 | https://doi.org/10.1002/pmrj.12890

#### **2022 PASC Pediatric Guidance Statement**

Systemic/ constitutional (Table 3)	Fatigue (generalized, exercise intolerance, or postexertional malaise) Sleep disturbances Fever	Respiratory/ pulmonary (Table 7)	Shortness of breath or dyspnea Chest (thoracic) pain or tightness Cough Difficulty with activity/exercise intolerance
Mental health and psychiatric (Table 4)	Anxiety Depression/low mood Increased somatic symptoms unexplained by systemic findings School avoidance Regression of academic or social milestones	Cardiology (Table 8)	Palpitations or tachycardia Dizziness/lightheadedness Syncope Chest pain Difficulty with activity/exercise intolerance
Autonomic dysfunction	Dizziness/lightheadedness Orthostatic intolerance	Otolaryngology (Table 9)	Abnormal (or no) smell or taste
(Table 5)	Nausea Syncope or presyncope	Musculoskeletal (Table 10)	Weakness Muscle, bone, or joint pain
Neurological (Table 6)	Headache Tremulousness Paresthesias or numbness Dizziness and vertigo Difficulty with attention/concentration Difficulty with memory Cognitive fatigue or "brain fog"	Gastrointestinal (Table 11)	Nausea/vomiting/reflux Abdominal pain Bowel irregularities (constipation diarrhea) Weight loss Lack of appetite



# **School Accommodations**

#### **Possible Interventions**

- Prioritizing academic demands & excuse/limit nonessential classwork/homework
- Increased time for exams or assignments (i.e., x1.5, x2.0) & rest breaks during instruction
- Copies of teacher notes prior to start of class/note taker in class
- Adjusted school days (i.e., shortened/alternative)
- Adapted PE or reduced demands during physical activity
- Elevator privileges
- Allow use of rolling backpack/school bag
- Allow access to water/salty snacks

Pacing both with physical and cognitive activity!

Make lifestyle interventions accessible at school



# Chronic illnesses with school absenteeism have long term impacts

- Severe or chronic medical illness result in <u>higher rates</u> of absenteeism (Carlton et al. 2021, Moonie et al. 2008, Weitzmann et al. 1986, Richardson et al. 2018)
- <u>Worse academic performance and/or long-term</u> <u>education attainment</u> occurs in children with some chronic medical conditions (e.g., cancer, diabetes, asthma) (Fleming et al. 2019, Lancashire et al. 2009, Gurney et al. 2009, Taras & Potts-Datema 2005)
  - Absenteeism alone partially explains poorer academic attainment (Fleming et al. 2019, Moonie et al. 2008)
  - Absenteeism in the early education can have educational and socioeconomic effects in adulthood (Ansari et al. 2020)



Published in: James G. Gurney; Kevin R. Krull; Nina Kadan-Lottick; H. Stacy Nicholson; Paul C. Nathan; Brad Zebrack; Jean M. Tersak; Kirsten K. Ness; *Journal of Clinical Oncology* 2009 272390-2395. DOI: 10.1200/JCO.2008.21.1458



#### **Considerations of Pediatric Long COVID**

**Developmental Trajectories** 



Tean et al. 2014

- Assessment of children is different:
  - Inability of younger children or children with developmental disabilities to verbalize symptoms
  - Children have fewer preexisting chronic health conditions → may not require the same laboratory or radiographic tests
  - Long COVID can represent a stark departure from baseline and have varied manifestations
  - Assessments dependent on expected developmental milestones

