The COVID-19 Impact

Exploring the long-term effects & management of COVID-19 cases

Paradigm

Speakers

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Course Objectives

Discuss the current state of COVID-19

Explore the persistent effects of COVID-19—Defining categories of persistent post-COVID symptoms

- Hospitalization related complications
  - Organ system related long-term effects
- Persistent symptoms without explicit organ impairment

Present COVID-19 case studies

Current State of COVID-19

The ever-changing societal impact

United States Current Status

As of March 10, 2022

79,248,406

People have been infected

US states, territories, and District of Columbia have reported 76,415,622 cases of COVID-19 in the United States.

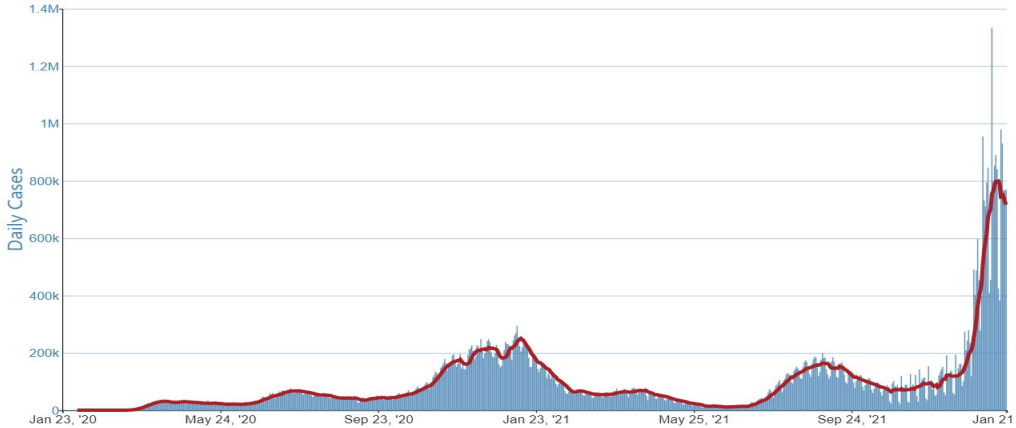
961,620

People have died

US states, territories, and District of Columbia have reported 961,620 death from COVID-19 in the United States.

Cumulative Daily Trends Since January 2020

COVID-19 cases in the U.S. reported to CDC



Emerging

- Initial cases identified
- Community spread begins
- No disruption to health care system
- Providers still accessible
- No impact on workers' comp claims

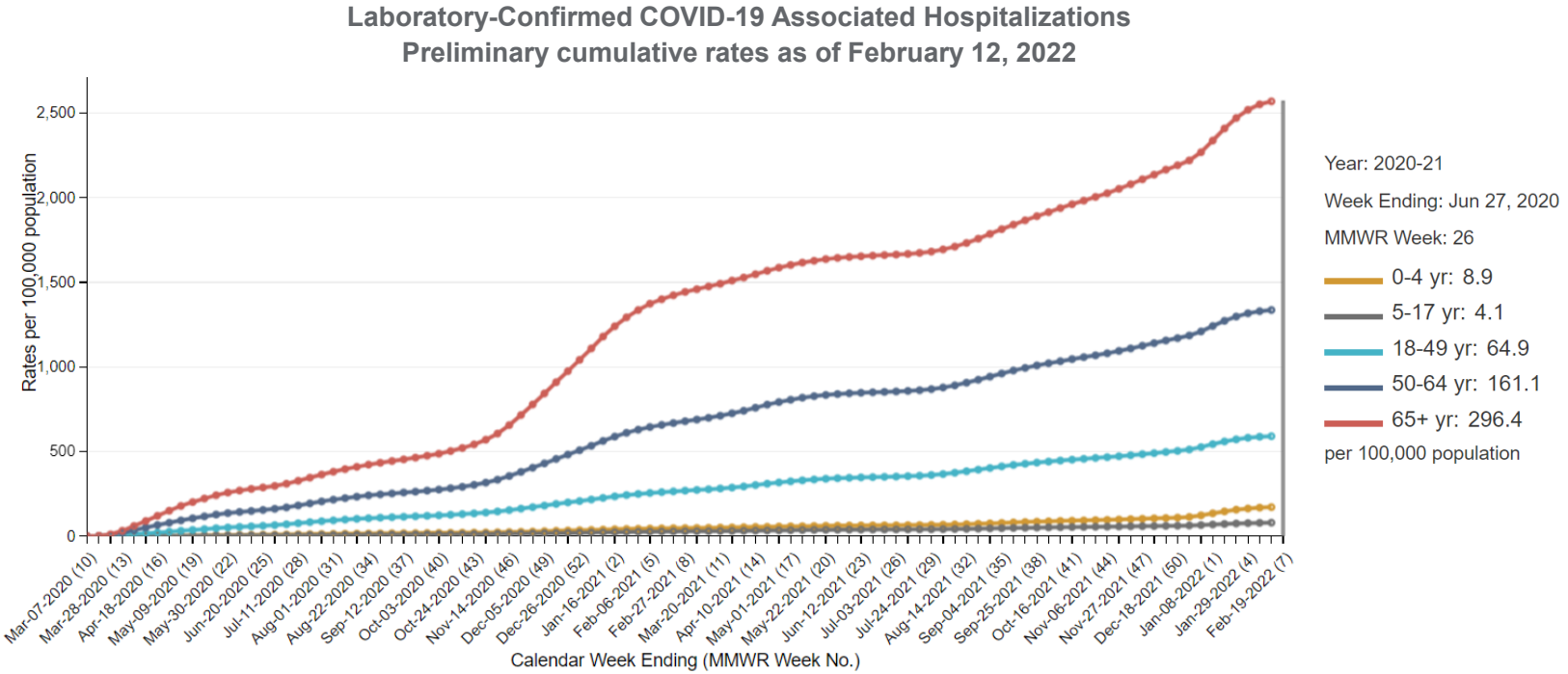
Rapid escalation

- Rapid growth in positive cases
- Severe access to care challenges
- Delivery through non-traditional sites of care
- Contraction in medical supply chain
- Evolving coverage positions for work-related COVID-19 claims

Undulating recovery

- Slowing vaccination rate in US
  - Fully vaccinated – 49%
  - State variations – MS/AL vs. VT/ME
- COVID-19 variants
  - Much more infectious
- Management of severe COVID-19 infections and persistent post-COVID symptoms

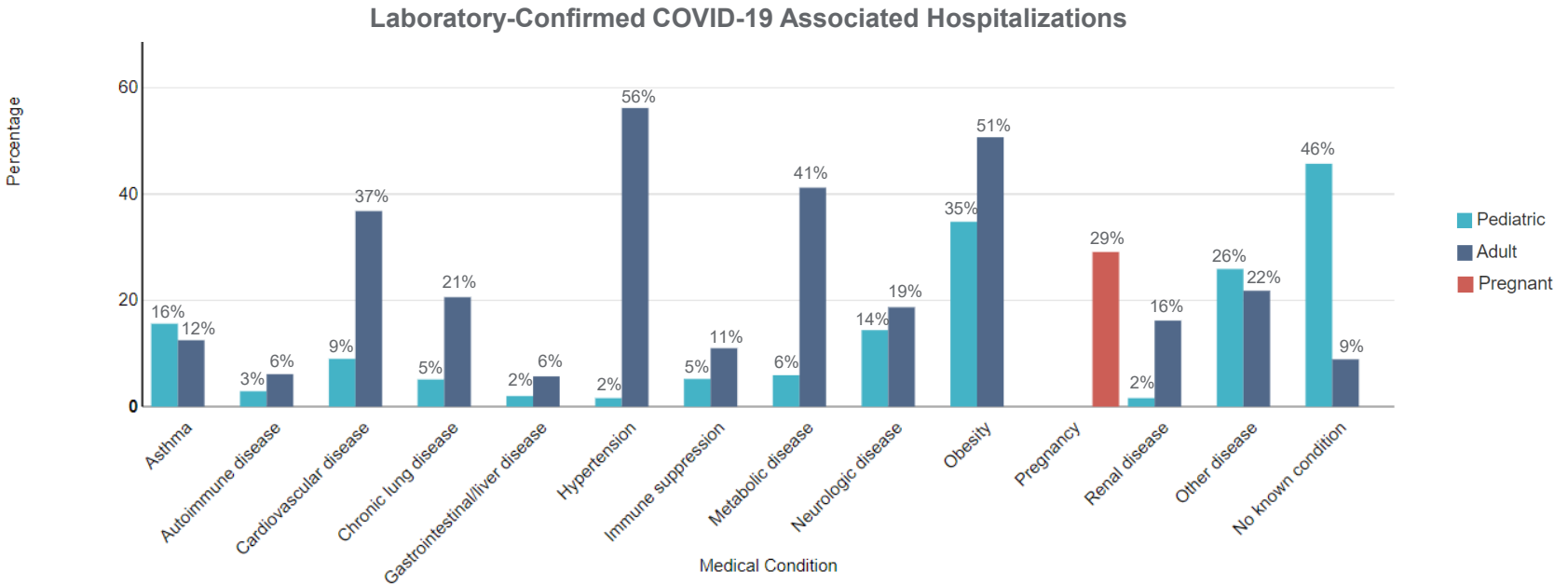
Hospitalizations According to Age Group



The Coronavirus Disease 2019 (COVID-19)-Associated Hospitalization Surveillance Network (COVID-NET) hospitalization data are preliminary and subject to change as more data become available. In particular, case counts and rates for recent hospital admissions are subject to lag. Lag for COVID-NET case identification and reporting might increase around holidays or during periods of increased hospital utilization. As data are received each week, prior case counts and rates are updated accordingly. COVID-NET conducts population-based surveillance for laboratory-confirmed COVID-19-associated hospitalizations in children (less than 18 years of age) and adults. COVID-NET covers nearly 100 counties in the 10 Emerging Infections Program (EIP) states (CA, CO, CT, GA, MD, MN, NM, NY, OR, TN) and four Influenza Hospitalization Surveillance Project (IHSP) states (IA, MI, OH, and UT). Incidence rates (per 100,000 population) are calculated using the National Center for Health Statistics' (NCHS) vintage 2020 bridged-race postcensal population estimates for the counties included in the surveillance catchment area. The rates provided are likely to be underestimated as COVID-19 hospitalizations might be missed due to test availability and provider or facility testing practices.

Source: https://gis.cdc.gov/grasp/COVIDNet/COVID19_3.html

Pre-existing Conditions related to Hospitalization



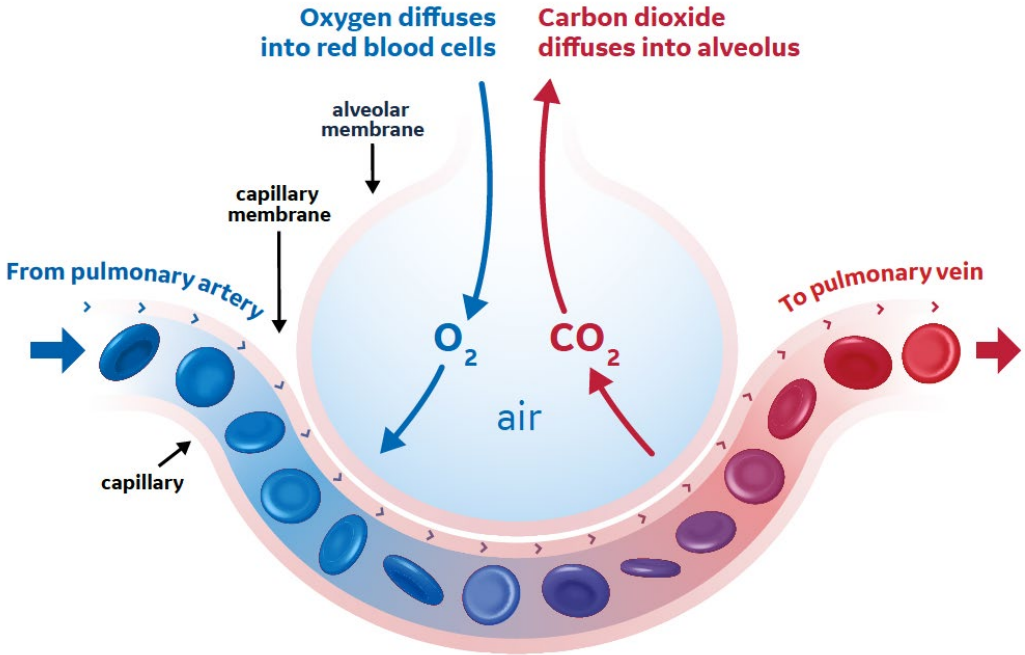
1. COVID-NET hospitalization data are preliminary and subject to change as more data become available. In particular, case counts and rates for recent hospital admissions are subject to delay. Lag for COVID-NET case identification and reporting might increase around holidays or during periods of increased hospital utilization. As data are received each week, prior case counts and rates are updated accordingly.

2. Data are restricted to cases reported during March 1, 2020 – December 31, 2021, due to delays in reporting. During this time frame, sampling was conducted among hospitalized adults aged ≥18 years; therefore, counts are not shown, and weighted percentages are reported. The denominator for percentages among adults includes sampled cases with data on these conditions. No sampling was conducted among hospitalized children; therefore, the denominator for percentages of underlying medical conditions among children includes all pediatric cases with data on these conditions. Underlying medical conditions among pregnant women are included when "Adults" and/or "Pediatrics" is selected.

https://gis.cdc.gov/grasp/COVIDNet/COVID19_5.html#virusTypeDiv

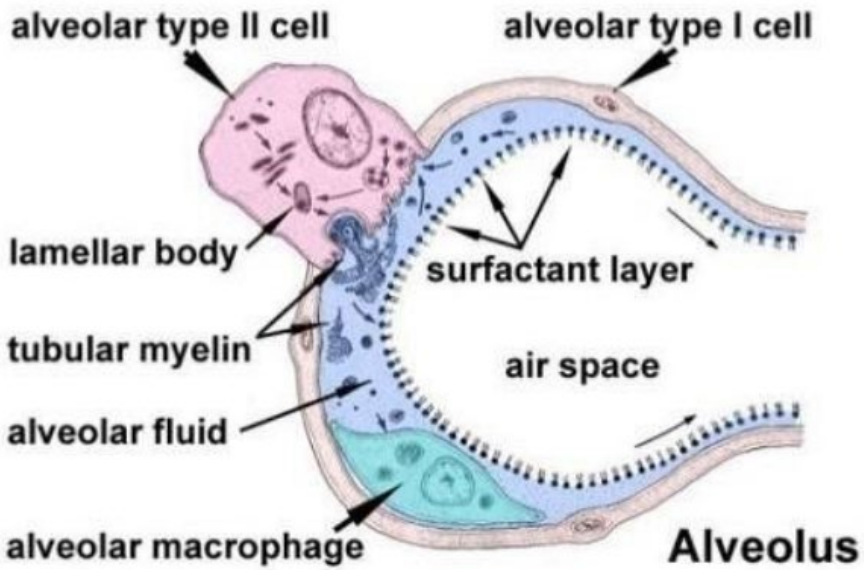
Hospitalization Related Complications

Lung Alveolus



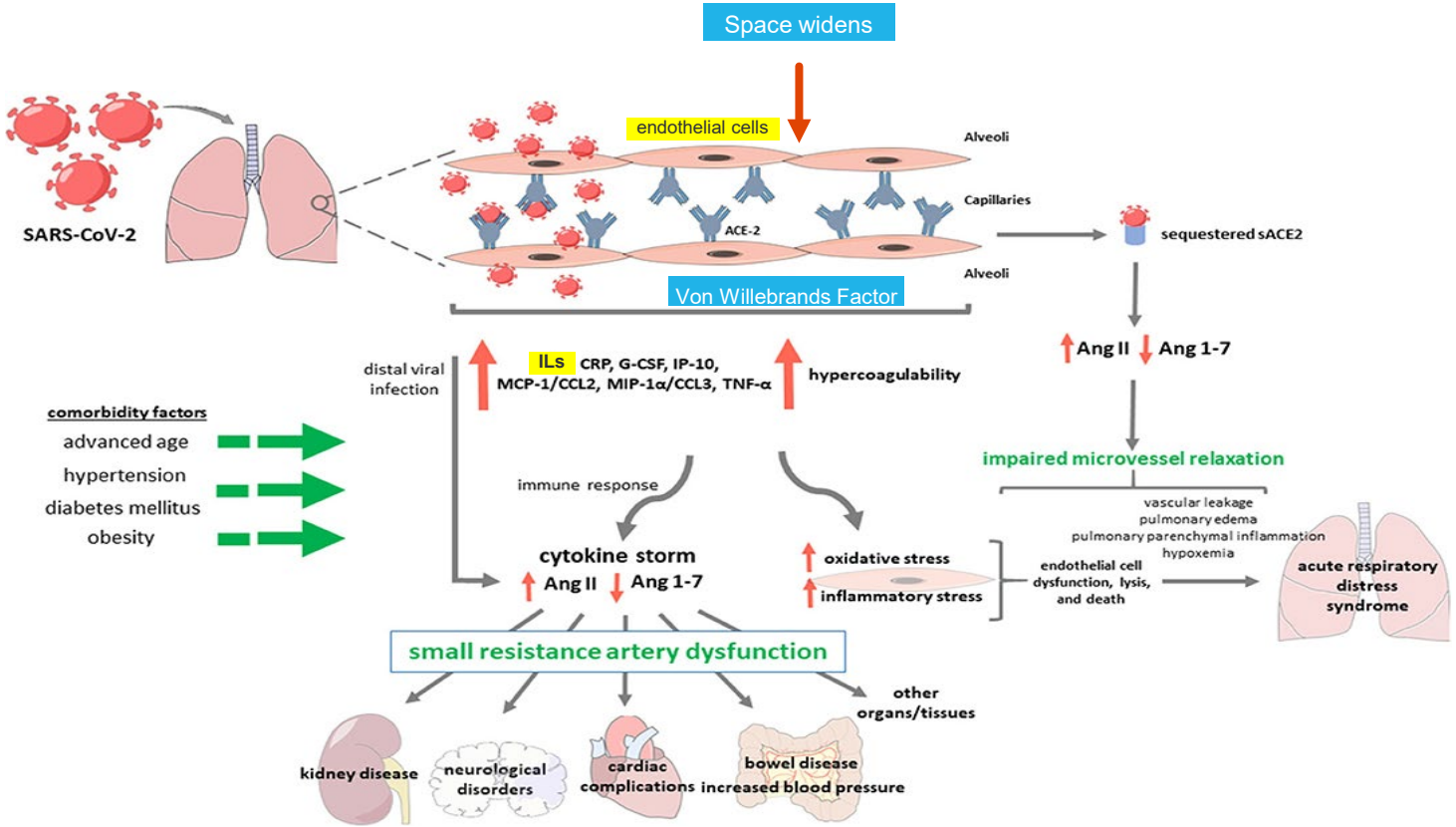
Source: https://clinicalview.gehealthcare.com/white-paper/clinical-research-applications-end-tidal-oxygen-measurement

Lung Alveolus



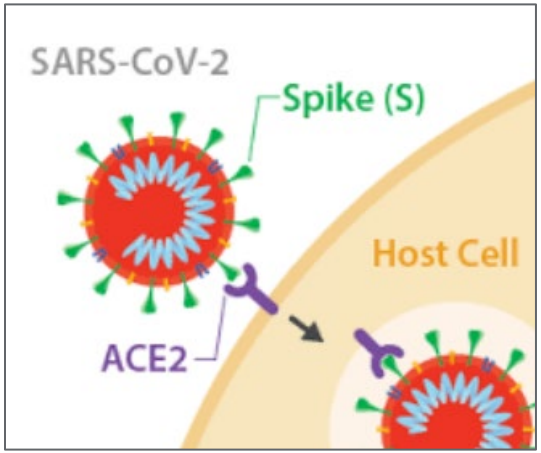
Source: https://www.researchgate.net/figure/Pulmonary-surfactant-system-https-imagesappgoogl-ai2eX4992dHCMuBQA_fig1_342654699

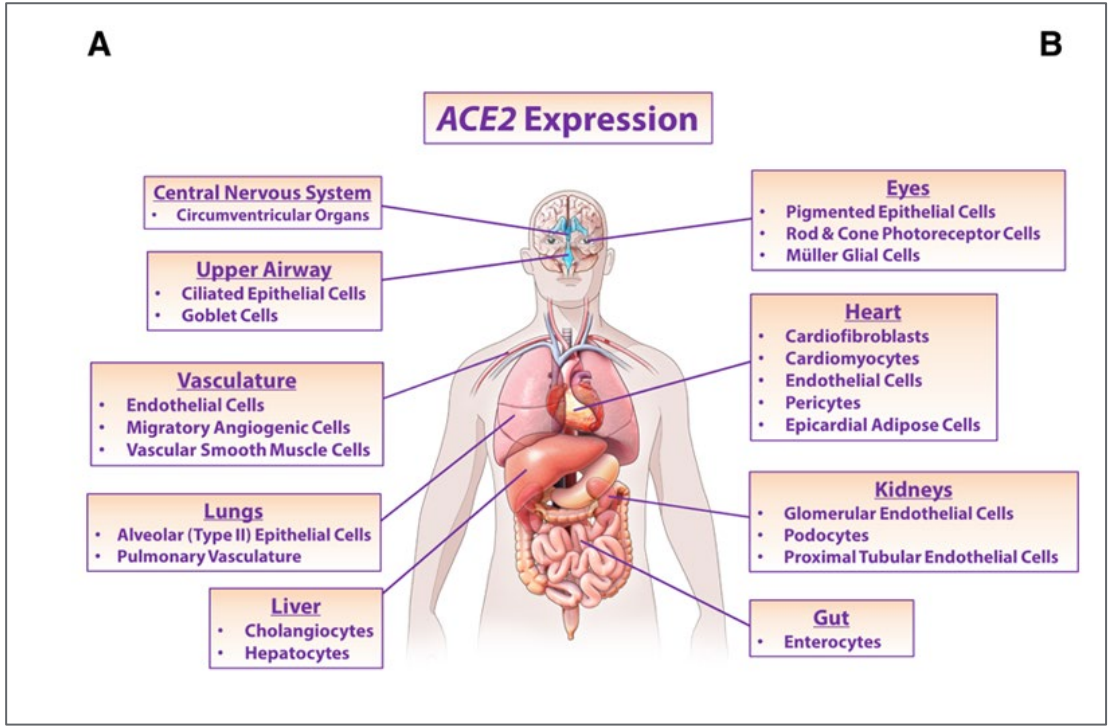
ACE-2 Receptors



Source: https://www.frontiersin.org/articles/10.3389/fcvm.2020.588692/full#F1

ACE-2 Receptors





Source: Gheblawi et al., 2020 AHA Journal

Systemic Complications During Hospitalization

Pulmonary

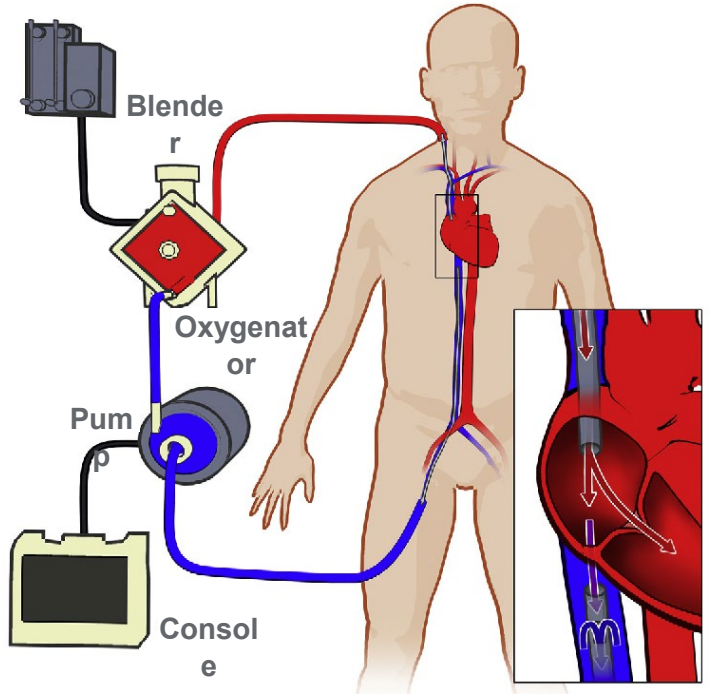
- **ARDS** – In an early study with 138 patients, median age 56 and 54.3% men, 20% developed ARDS within 8 days, and 12.3% were on mechanical ventilation (*JAMA 2020;323(11):1061)*.
- In a U.S. combined study with 5,700 patients, median age 63 and 39.7% female, 14.2% treated in the ICU receiving mechanical ventilation, 3.2% CRRT (*JAMA 2020;323(20):2052*).
- In another study with 5,279 patients, 24.3% died, 23.6% required ventilation (*BMJ 2020; 369:m1966. Epub 2020 May 22*).

Pulmonary

Worst case scenario

Extracorporeal Membrane Oxygenation (ECMO):

Only based on local resources and protocols



Source: https://www.semanticscholar.org/paper/Novel-Uses-of-Extracorporeal-Membrane-Oxygenation-Abrams-Brodie/243e1ad7f89ccf83191da21b2f5ed6bbd631f4f3

Pulmonary

Other complications

- Fibrosis – post d/c can only imply by % of pt requiring O2 and/or dyspnea
- Pneumothorax – seen frequently but unknown percentage
- Pulmonary blebs

“Some, but not all COVID-19 patients who develop ARDS may go on to develop lung fibrosis—scarring of the lungs—which may be permanent. Post-ARDS fibrosis typically is not progressive, but nonetheless can be severe and limiting. The recovery period for post-ARDS fibrosis is approximately one year and the residual deficits persist.”

- The Pulmonary Fibrosis Foundation

Pulmonary

- Long-term O2 requirements
- Long-term pulmonary compromise
- **Dr. Englund will cover this in a moment**

Myocardial Effects

- **Most patients with COVID-19 with cardiac abnormalities** on cardiac testing (cardiac troponin elevation, asymptomatic cardiac arrhythmias, or abnormalities on cardiac imaging) **have no symptoms or some have minimal symptoms:**
  - There have been reports of stress cardiomyopathy – " broken heart" (Takotsubo)

Source: Am Coll Cardiol. 2020;76(10): 1244: Epub 2020 Jul 8. J Am Coll Cardiol. 2020;76(5):628 and others genome identification techniques

Cardiac Issues

- Myocardial injury and heart failure – myocarditis[1]
  - Clinically suspected, but few cases of histologically confirmed myocarditis, mostly just case studies[1]
- Because of age, a relatively high percentage of patients will have underlying CAD.[2]
- It is likely that COVID-19 either directly or indirectly affects the CVS causing or contributing to acute coronary syndrome (ACS)[2]
- Potential mechanisms may include: 1. direct injury 2. hypoxemia 3. Inflammatory myocarditis 4. stress 5. thrombosis due to hypercoagulability 6. SIRS (cytokine storm)[2]
- Studies suggest that COVID-19 increases the risk of acute MI[2]

Source:
[1] JAMA Cardiol. 2020;5(7):819, Some via endocardial biopsy, A study in Germany, of 104 investigated 5 were confirmed histologically/ ESC Heart Fail. 2020;7/(5): 2440
[2] Circulation 2020; 142(21):2080

Cardiac Issues

- Patients with known history of heart failure may suffer an acute decompensation due to the infection[1]
- A study of 6,439 patients hospitalized with COVID-19 found a history of HF was associated with adverse outcomes: longer length of stay, increased risk of mechanical ventilation, and mortality (40% vs. 24.9%)[2]
- This may include patients with RHF due to acute pulmonary embolism and/or ARDS from COVID-19 infection[3]
- Other reports of cardiogenic shock

Source:
[1] Dong; et al; ACC Heart Failure:2020;8(6); 515
[2] J. Am Coll Cardiol: 2020; 76(20):2334
[3] N Engl J Med: 2020;382(21)

Neurologic Complications – Acute and Long-Term

- Encephalopathy – in one series 1/3 of patients were diagnosed, but older (66 vs 55 y/o)[1]
- Strokes, movement disorders, motor & sensory deficits, ataxia, and seizures occur less frequently[2]
- Critical Illness Neuropathy vs. GBS
- Cognitive Impairment
- Seizures have also been reported

Source:
[1] Ann Clin Tranl Neurol. 2020; 7(11): 2221
[2] Epilepsy Behav. 2021:118;107923

Renal Complications

Acute kidney injury

- Several studies have demonstrated development of AKI.
- Study of 193 patients with COVID-19 infection:
  - 66% non-severe; 28% developed AKI
  - At time of admission:
    - 14% had elev BUN and 10% elevated sCreat
    - 60% had Proteinuria and 48% hematuria

Source: Li Z,et al. medRxiv. 2020

Renal Complications

Other issues during acute hospitalization

- Chronic kidney failure
- CRRT/HD

Data on AKI in Patients with COVID-19 from Major Clinical Cohort Studies

Paper	Study Population	Risk of AKI	Need for CRRT	Comorbid Conditions
Guan et al 2	n = 1099 552 Hospitals 30 Regions in China	6 (0.5%)*	0.8%	**DM: 7.4%** **HTN: 15%** **CKD: 0.7%**
Huang et al 3	n = 41 Jinyintan Hospital Wuhan	3 (7%)	Not reported	**DM: 20%** **HTN: 15%** **CKD: 10% (defined as creatine > 1.5mg/dL on admission)**
Chen et al 26	n = 99 Jinyintan Hospital Wuhan	3 (3%)	9%	**CVD: 40%** **DM: 12%**
Wang et al 25	n = 221 Single center Zhongnan Hospital, Wuhan	5 (3.6%)	1.45%	**DM: 10%** **HTN: 31%** **CKD: 2.9%**
Chen et al 73	n = 274 Tongji Hospital Wuhan	29 (11%)	1%	**DM: 17%** **HTN: 34%** **CKD: 1%**
Cheng et al 74	n = 701 Tongji Hospital Wuhan	36 (5%)* Stage 1: 2% Stage 2: 1% Stage 3: 2%		**With ≥ 1 co-morbidity: 43%** **DM: 14%** **HTN: 33%** **CKD: 2%**
Arentz et al 75	n = 21 Critically ill patients Evergreen Hospital, Seattle	4 (19%)*	Not reported	**With ≥ 1 co-morbidity: 86%**

Source: Zaim, S et al, Current Problems in Cardiology Vol 45, Issue8, Aug 2020 100618

Gastrointestinal Effects/Complications

- A significant number of patients reported GI symptoms such as diarrhea, nausea, vomiting, and abdominal pain, with some reporting these symptoms as their sole presenting complaint.

- The incidence of GI symptoms, alongside the detection of SARS-CoV-2 RNA in stool samples of infected patients, suggest that ACE2 receptors highly expressed in the GI tract are another target for SARS-CoV-2 infection.

Source: Wong SH et al. J Gastroenterol Hepatol March 25, 2020

Gastrointestinal Issues

Other acute and presenting symptoms

- Bowel ischemia
- GI bleeding
- Pancreatitis
- Mesenteric ischemia

Musculoskeletal

- Myalgias
- Myositis
- Necrotizing Myositis
- Muscle loss
- Critical Illness Myopathy

Hypercoagulability and COVID-19

- Mild thrombocytopenia
- Increased D-dimer levels
- Increased fibrin degradation products
- Prolonged Prothrombin time
- Elevated D-dimer strongly associated with greater risk of death

Hypercoagulability and COVID-19

- Overall reported in as many as 71% of non-survivors, compared to 0.6% survivors.
- Treatment with anticoagulation: LMWH or unfractionated heparin improved outcomes in severe cases of coagulopathy.

Source: Tang N. March J Thromb Haemost 2020 Tang N, March J Thromb Haemost 2020

Hypercoagulability and COVID-19

- Microvascular Thrombosis of the toes “ COVID toes”
- Clotting of intra-vascular catheters
- Myocardial injury with ST elevation
- Large vessel strokes
- Pathogenesis – Treatment: VTE prophylaxis

Patients with Severe COVID-19 Twice as Likely to Require Future Hospitalizations

Study details

- **2 million+** Americans have been hospitalized for COVID-19 since August 1, 2020
- **10,646** patients heath record data analyzed
- **114 serve** COVID-19 requiring hospitalization
- **211 mild to moderate** COVID-19 requiring hospitalization
- Subsequent hospitalization for varying problems:
  - Neurologic
  - Cardiac
  - Pulmonary

> While a growing number of studies have explored long-term health complications among people who have recovered from COVID-19, most have focused on more mild symptoms such as altered sense of smell or taste or difficulty concentrating. The UF study, which appears in the Journal of the American Board of Family Medicine, is among the first to explore serious outcomes among people who have recovered from the disease.

Source: Risk of New Hospitalization Post COVID-19 Infection for Non-COVID-19 Conditions, Arch G. Mainous III, PhD1,2; Benjamin J. Rooks, MS1; Frank A. Orlando, MD1 , https://explore.research.ufl.edu/patients-with-severe-covid-19-twice-as-likely-to-require-future-hospitalizations-for-other-illnesses.html

Long-Term COVID

Case Study #1

Background

- 54 y/o BF
- **Co-morbidities:** IDDM, Diastolic heart failure, Asthma, Obstructive Sleep Apnea, Morbid Obesity (BMI 58), COPD and more
- **Occupation:** Respiratory Therapist

Timeline

- Tested + for COVID-19 early 2020
- Discharged after 12 days without intubation
- Readmitted 3 days later for dyspnea and discharged home after 5 days
- Readmitted for A-flutter requiring cardioversion for P-160 and symptomatic. Still COVID-19 +
- During these admissions and the next 3 months Blood glucose was noted to be continuously elevated
- After 7 months, she remained on O2, blood glucose was in the 300's, 40 lb weight gain, requiring increasing doses of diuretics for urine output
- Vision began failing, A1C had gone from 5.6 before to 9.3 after infection
- Nephrology was removing fluid 3 x/wk (2-3L) via UF, Also K+ was chronically low, unable to absorb via GI tract
- Now 21 months later she has Stage IV Renal Failure requiring dialysis, chronic hyperglycemia, chronic lung disease though off continuous O2, new onset A-fib with rate control.

COVID-19 Acute Complications

What can we conclude?

- The ACE-2 receptor appears to be one of the major reasons so many body systems are involved
- Early intervention to minimize the “cytokine storm” does appear to help, but timing is everything
- Early anticoagulation does appear to help
- There are many adjuvant therapies in our armamentarium that can support the patient and help survival
- HF O2, prone ventilation, convalescent plasma, anti-viral medications, CRRT, HD, ECMO, steroids

Persistent Symptoms Without Explicit Organ Impairment

Post-COVID Conditions

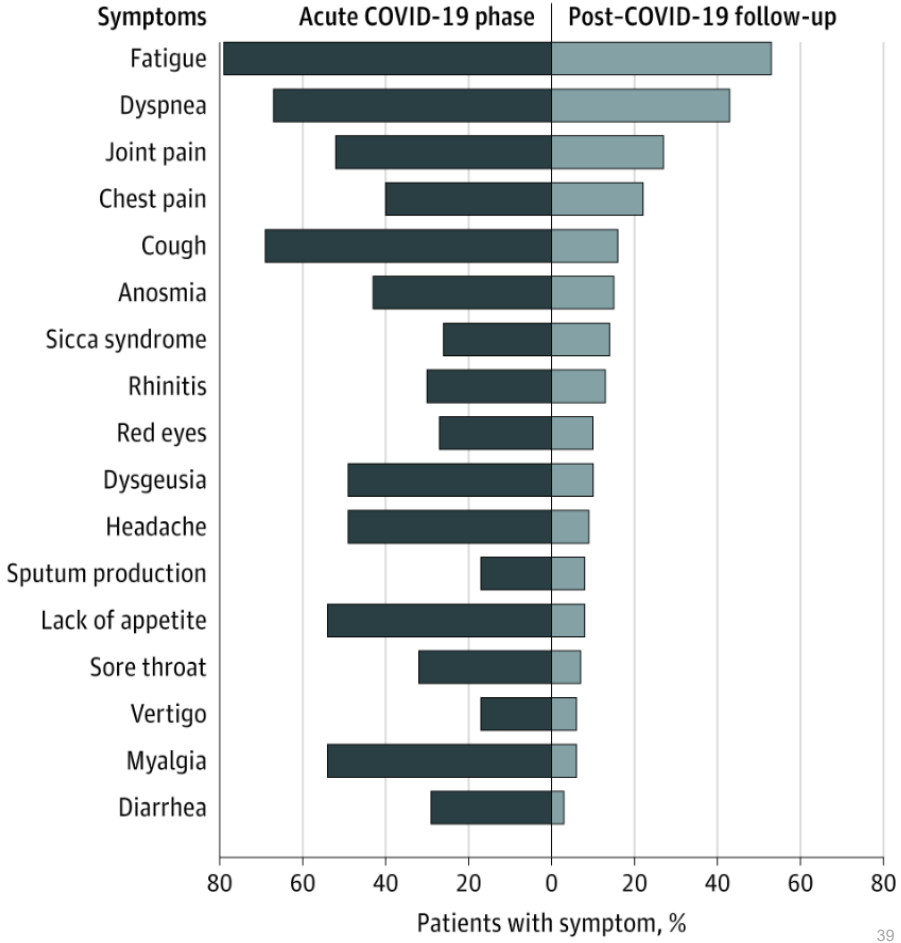
- "Post-COVID conditions" is an umbrella term for the wide range of physical and mental health consequences that are present four or more weeks after SARS-CoV-2 infection, including by patients who had initial mild or asymptomatic acute infection
  - Associated with a spectrum of physical, social, and psychological consequences
  - Conditions are heterogeneous and attributable to different underlying pathophysiologic processes
- "Long COVID" is used by many patients for post-COVID conditions

Source: Post-COVID Conditions: Information for Healthcare Providers: https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/post-covid-conditions.html

Post-COVID/Long COVID Syndrome

- At 6 months, 76% of all patients who had been hospitalized (cohort of 1733) had at least one persistent symptom (Huang, January 2021).
- From the UK, 66% of young, low risk patients had signs of damage in one or more organ systems 4 months after COVID diagnosis. 18% were hospitalized (BMJ, Iacobucci, November 2020).
- Surveys in France, Faroe Islands, and Switzerland reported 35-54% of patients with mild acute sxs had persistent sxs after 2-4 months. 50-76% of patients reported new symptoms (COCA Podcast, CDC 1/28/2021).
- The Ohio State University reported 15% incidence of myocarditis in competitive athletes with mild sxs. (Rajpal et al. JAMA cardiol, Sept 2020).

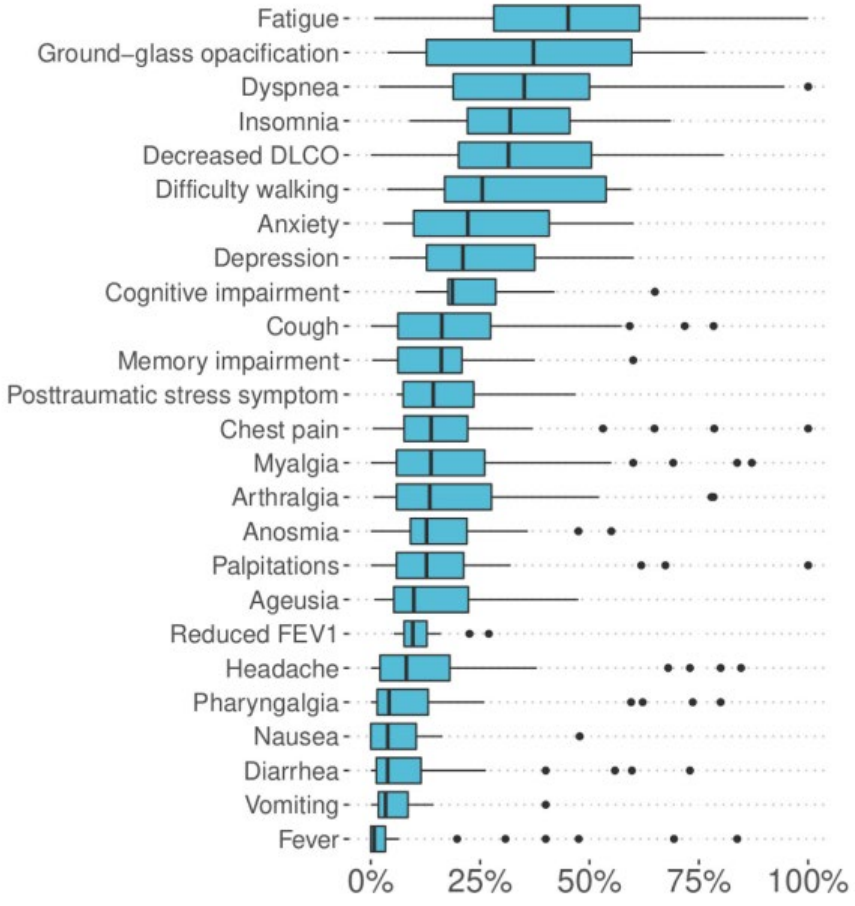
Broad Range of Symptoms Initially Reported



Source: JAMA Research Letter August 11, 2020
Persistent Symptoms in Patients After Acute COVID-19
Angelo Carfì, MD; Roberto Bernabei, MD; Francesco Landi, MD, PhD; for the Gemelli Against COVID-19 Post-Acute Care Study Group

Characterizing Long COVID: Deep phenotype of a Complex Condition

- Identified 59 manuscripts with 81 cohorts that described 287 clinical manifestations of long COVID
- Broader range of symptoms
- Highlights need to use similar terminology



Source: R.R. Deer et al./EBioMedicine 74 (2021) 103772

One Year Outcomes in Hospital Survivors with COVID-19

A longitudinal cohort study

- 1,276 COVID-19 survivors, hospitalized in Wuhan, China between Jan 7 and May 29, 2020
- One sequelae symptom at 6 months: 68%
- One sequelae symptom at 12 months: 49%
- Male 53%, average age 59 years
- 88% returned to their original work at 12 months
- Matched COVID-19 survivors at 12 months had more problems with mobility, pain or discomfort, anxiety and depression than did controls

Source: www.thelancet.com; Vol 398; August 28, 2021

Potential Long COVID Patients

Assuming 10% of COVID cases have PASC we will need to treat:*

45.2M

Worldwide

7.93M

United States

266K

Ohio

*Data as of 3/10/2022

Case Study

- KS-38 YO Female, with no significant PMHx
- Initially diagnosed with COVID 11/20
- Mild case that did not require hospitalization or any interventions
- Seen in reCOVer clinic in 7/21 and 8/21
- Symptoms:
  - Dyspnea
  - Tachycardia
  - Exercise intolerance/fatigue
  - Brain fog
  - Depression
- Had been to the local ER prior to being referred by her PCP for Palpitations
- ER work up including was negative. EKG showed sinus tachycardia

Source: BriBBritish Safety Council

Case Work Up

- **Vitals:** BP 126/78, P 104, Pulse OX 100%
- Exam Unremarkable
- **Orders:** Chest x-ray and EKG held due to recently being negative; no pft's in absence of respiratory complaints
- Routine COVID reCOVer panel labs performed
- Consults: Cardiology
    - Neurology
    - Wellness
    - Continue follow up with PCP for treatment of depression/seeing counseling
- **Lab: Echo** – normal EF with no abnormal valvular findings
    - Abnormal lab: TSH .257 (.270-4.200 uU/ml)
        - VIT D 115 (31-80ng/ml)
- **Outcome of second visit:** Added Endocrinology referral and vitamin D held

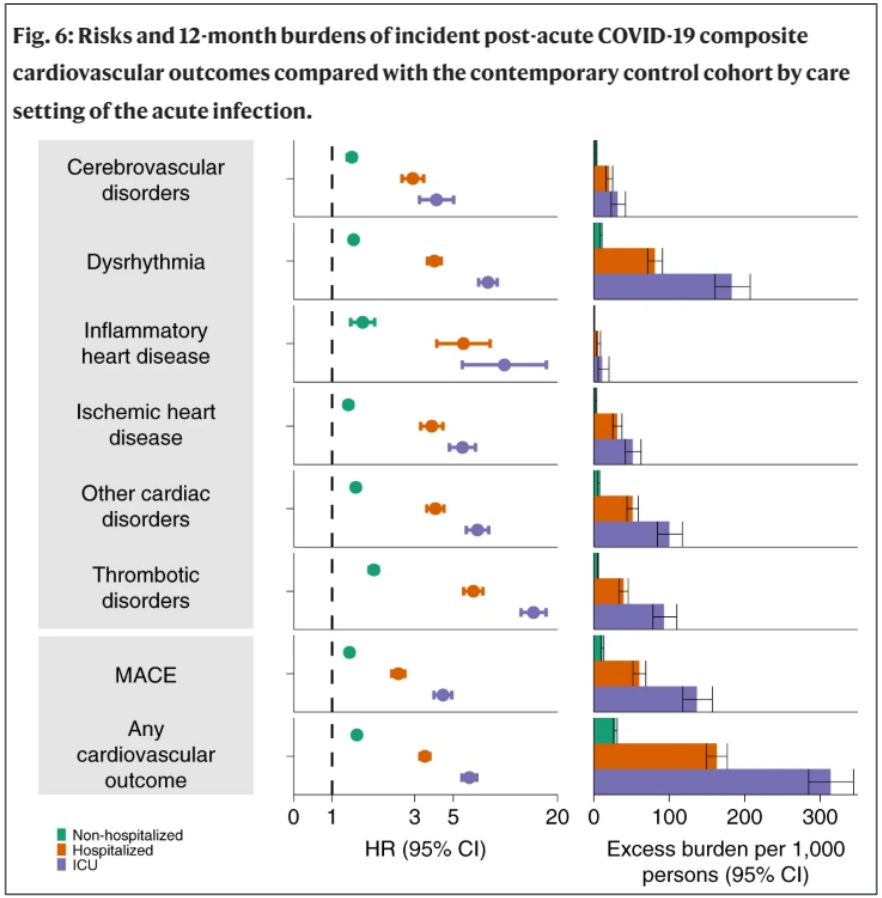
Can We Define PASC Into Subgroups?

- Cardiovascular
- Neurologic
- Pulmonary
- GI
- Musculoskeletal

Long-Term Cardiovascular Outcomes of COVID-19

One year study from the US Department of VA national healthcare database.

- 153,760 COVID patients
- 5,637,647 contemporary controls
- 5,859,411 historic controls (2017)



Source: naturemedicine; Yan- Xie, Evan Xu, Benjamin Bowe and Ziyad Al-Aly; Published 07 February 2022

Neurocognitive Profiles in Patients with Persisting Cognitive Symptoms Associated with COVID-19

- Patients with prior psychiatric history may experience greater levels of cognitive dysfunction.
- Cognitive deficits, when present, appear mild and isolated to domains of attention and processing speed, and executive function
- This finding may be a consequence of other factors developed as a result of COVID-19 (worsening mood, sleep disruption, fatigue, etc.) rather than a direct result of COVID-19 infection.
- Patients appear receptive to psychoeducation about the impact of factors such as mood, pain, sleep, and fatigue on cognition.

Source: Kamini Krishnan 1 2, Ashley K Miller 1, Katherine Reiter 1 2, Aaron Bonner-Jackson 1 2 Arch Clin Neuropsych 2022 Feb 5

Sleep Disturbance in PASC

- 1,321 patients, 682 completed PROMIS Sleep disturbance questionnaire
- The prevalence of moderate to severe sleep disturbances reported by patients presenting for PASC was very high (41.2%) and associated with obesity, black race, and mood symptoms.
- Notably, after adjustment for demographics, black race conferred a 3-fold higher odds of moderate-severe sleep disturbance emphasizing the need to characterize race-specific determinants and disparities in COVID-19 survivors.

Source: Data from Reena Mehra, MD, MS Cleveland Clinic

The Possible Association Between COVID-19 and Postural Tachycardia Syndrome

- Sustained heart rate increment > 30 beats/min within 10 minutes of standing or head up tilt.
- Sxs: chest pain, palpitations, exercise intolerance, orthostatic intolerance
- Other sxs: brain fog, GI issues, chronic pain, sleep abnormalities

Source: David S. Goldstein MD PhD. Heart Rhythm. 2021 Apr; 18(4): 508–509.

Postural Orthostatic Tachycardia Syndrome (POTS)

- Extended time at bedrest during COVID illness and recovery can lead to postural hypotension.
- Vasculitis during COVID-19 can lead to baroceptor damage resulting in autonomic dysregulation.
- Increase in cytokines can damage the autonomic nervous system.
- POTS can lead to an increase in falls, possibly associated with syncope. Persons who fall frequently or who are unsteady are likely to develop “fear of falling”.

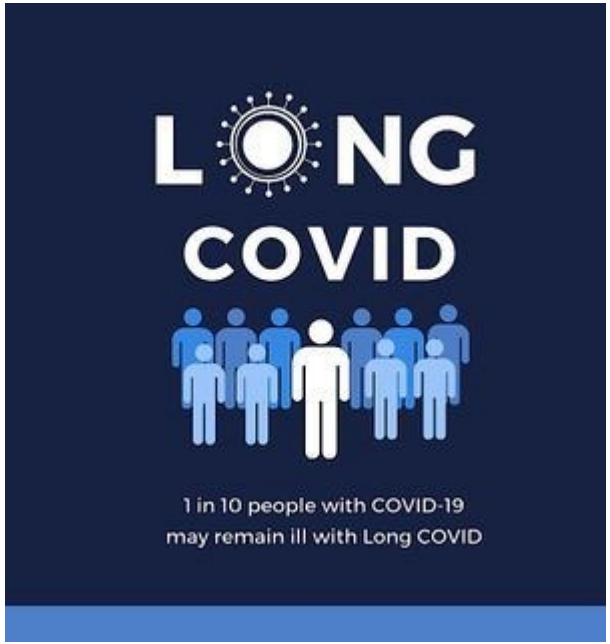
Mechanisms of Neurologic damage

- Virus breaks blood brain barrier through olfactory mucosa
- Affects astrocytes, directly or indirectly, not neurons
- SARS-CoV2 can affect pericytes causing capillaries to constrict
- Thromboses
- Autoantibodies directly attack brain tissue
- Pre-print article proposing grey matter loss

Source: Michael Marshall. COVID and the brain: researchers zero in on how damage occurs. Nature 595, 484-485 (2021)

GI Manifestations of Long COVID

- Inflammation and Dysbiosis
- “Post-gastroenteritis gastroparesis syndrome"
- Diarrhea
- Dyspepsia
- Abdominal pain



Source:technologynetworks.com

Pulmonary Symptoms of Long COVID

- Many long COVID-19 patients suffer from symptoms of lung damage, including breathlessness, coughing, and limited ability to exercise
- Decreased DLCO most frequently found PFT abnormality
- COVID-19 can lead to damage in the lungs due to the direct effects of the virus also the immune system's reaction. After the virus clears, the inflammation may persist.
- In severe cases, interstitial lung disease develops

Association of Obesity with Post-Acute Sequelae of COVID-19

- 2,839 patients had charts reviewed up to eight months beyond acute COVID infection.
- Risk of hospital admission was 28% and 30% higher in patients with moderate and severe obesity, respectively.
- Need for diagnostic tests to assess different medical problems was 25% and 39% higher in patients with moderate and severe obesity, respectively.

Source: Ali Aminian MD et al. Diabetes, Obesity and Metabolism Vol 23, Issue 9, Sept 2021, 2183-2188

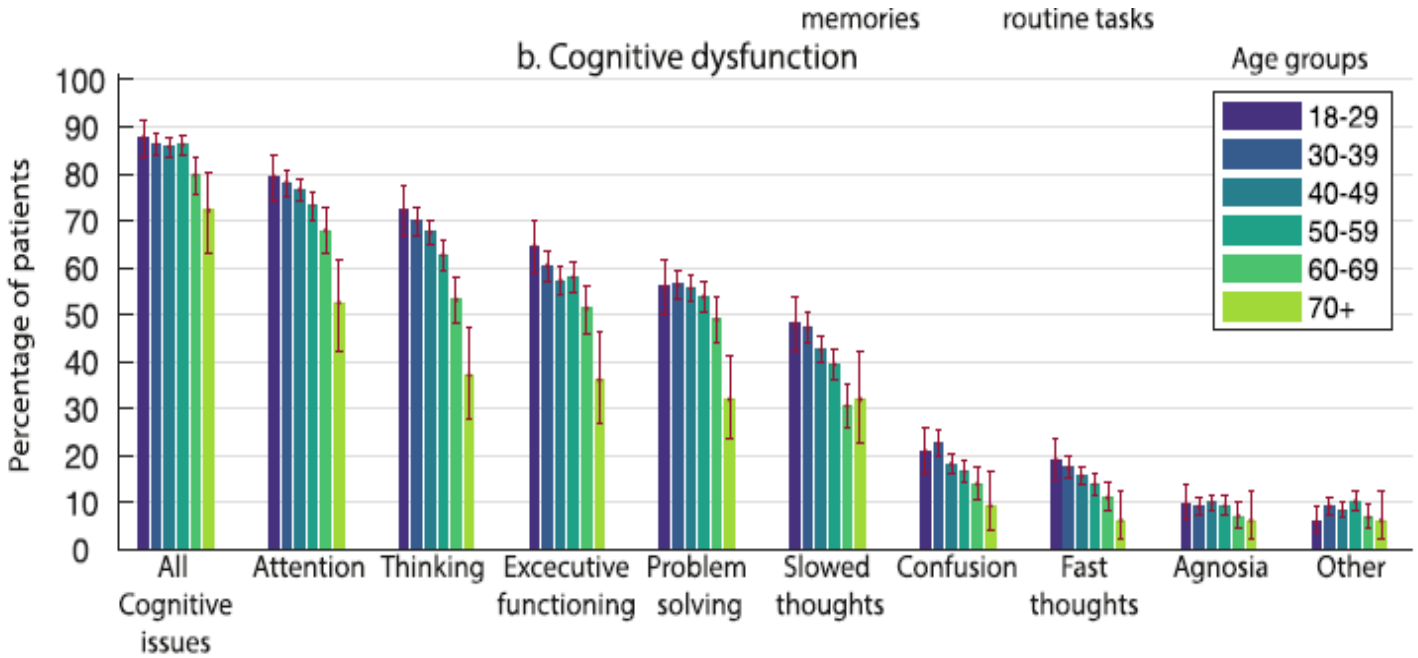
Characterizing Long COVID in an International Cohort:

Seven months of symptoms and their impact

- 6,500 patients with long COVID from 56 countries
- For >91% time to recovery exceeded 35 weeks
- Most frequent symptoms after month six were fatigue, post-exertional malaise, and cognitive dysfunction.
- 85.9% of participants experienced relapses, primarily triggered by exercise, physical or mental activity, and stress.
- 1,700 respondents (45.2%) required a reduced work schedule compared to pre-illness, and an additional 839 (22.3%) were not working at the time of survey due to illness.
- Cognitive dysfunction or memory issues were common across all age groups (~88%).

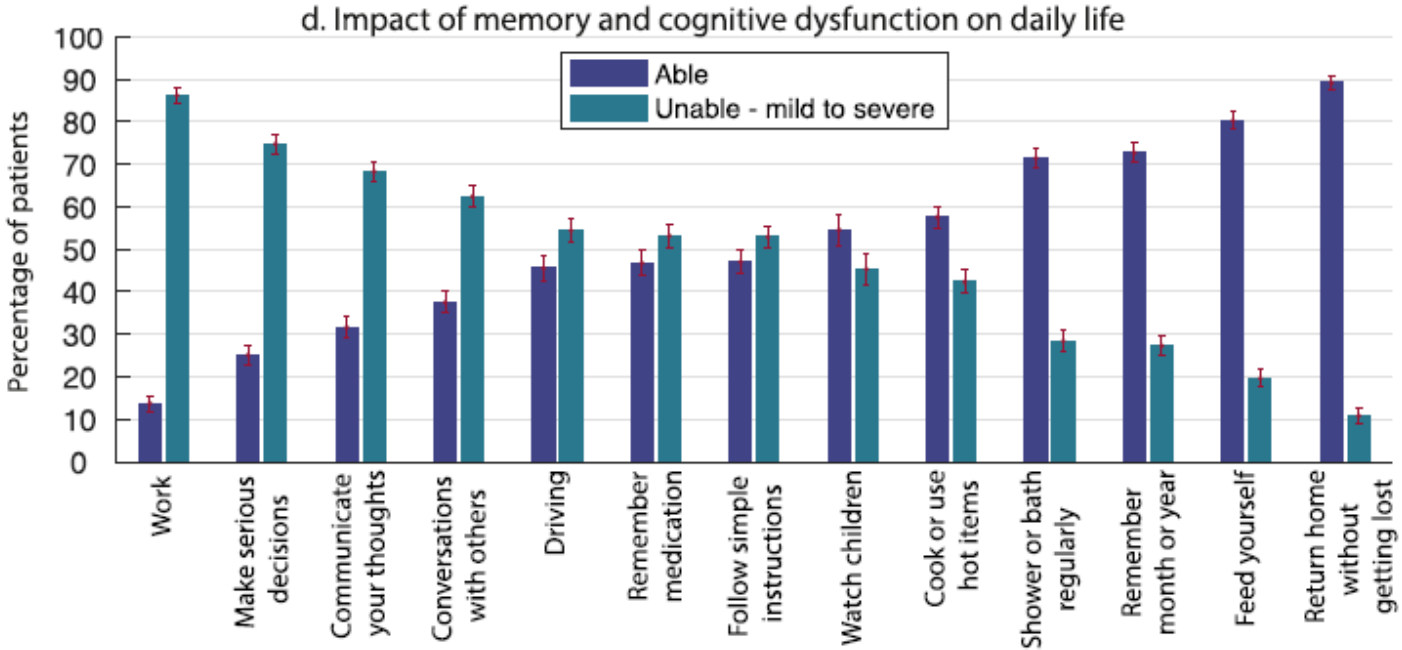
Source: Hannah E. Davis et al. e. clinical medicine The Lancet. Volume 38, August 1, 2021

Cognitive Dysfunction



Source: Hannah E. Davis et al. e. clinical medicine The Lancet. Volume 38, August 1, 2021

Impact of Memory and Cognitive Dysfunction on Daily Life



Source: Hannah E. Davis et al. e. clinical medicine The Lancet. Volume 38, August 1, 2021

reCOVer Clinic: First 1,372 Patients

- 72% female
- 77% white
- Mean age 49.0 (18-87 yo)
- Mean BMI 31.67
- 29% hospitalized

Symptoms:

- 87% fatigue
- 73% SOB or DOE
- 72% lack of concentration/brain fog
- 52% difficulty sleeping
- 48% dizziness
- 28% palpitations

- PROMIS fatigue 10th percentile
- Neuro QOL Cognitive function 14th percentile
- Depression (PHQ 2/9) 35%
- Anxiety (GAD 2/7) 36%
- PTSD (PPCL-5) not significant

How Can We Treat These Patients?

The effectiveness of vaccination against long COVID

- 15 studies reviewed
- Vaccinated people who are subsequently infected with COVID-19 are less likely to report symptoms of long COVID
- Unvaccinated people with long COVID who were subsequently vaccinated had on average reduced long COVID symptoms

Source: UK Health Security Agency

How Can We Treat These Patients?

- **Cardiology:** diagnose and treat POTS, tachycardia, myocarditis, cardiac rehab
- **Neuro:** treat headaches, POTS, stroke
- **Sleep:** treat sleep disorders
- **GI:** treat IBS
- **ENT:** sensory retraining, vestibular training
- **Neurocognitive:** speech therapy for memory retraining, behavioral health
- **Physical Therapy:** strength, balance, breathing techniques, vestibular training
- **Pulmonary:** Treat pulmonary fibrosis, pulmonary rehab
- **Integrative Medicine and Functional Medicine:** shared medical appointments for 6-9 week sessions – Nutrition, sleep hygiene, exercise, wellness

Case Outcome

- **Cardiology:** Tilt Table Equivocal; Tachycardia blunted testing
  - Normal Stress Test
  - Holter: baseline sinus tach with 31 seconds of SVT
  - Begun on metoprolol for likely POTS/autonomic dysfunction due to COVID

- **Neurology:** Diagnosed with POTS
  - Referred to Neuromuscular SMA to focus on nonpharmacological treatment
  - Referred to Cardiac syncope clinic who are adjusting meds

- **Wellness:** Discussed supplements and inflammatory reducing diet

- **Endocrinology:** Repeat labs showed she was euthyroid; felt it was due to recent illness

- **Follow up with PCP:** slowly improving – they continue to adjust meds for her POTS and depression; she was recently diagnosed with a second case of COVID-19

Key Takeaways

- Long COVID is real
- Long COVID can be very debilitating, affecting each patient uniquely
- Symptoms may be seen in almost any organ system
- Multimodal care is required for recovery
- Research ongoing regarding molecular level etiology and treatments

Thank you

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