Potential Long-Term Impact of COVID-19 Medical Problems

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Agenda

• What are the major long-term health problems due to COVID-19?
• What is their impact on function and the ability to work?
• Who is affected?
• What is the effect on long term survival?
Defining Chronic Post-Covid-19 Syndromes

From the onset of first symptoms:

- **Post-acute COVID** > 3 weeks
- **Chronic COVID-19**
  - "Long Covid"
  - "Long-haul Syndrome" > 12 wks
- A positive COVID-19 PCR test is *not* a pre-requisite for diagnosis (many not tested, or in a timely way, false negative tests common)
- Can occur after mild disease
- Occurs at any age, most late 50’s

Greenhalgh T, et al. BMJ 2020;370:m3026 [http://dx.doi.org/10.1136/bmj.m3026](http://dx.doi.org/10.1136/bmj.m3026)
Chronic Symptoms after COVID-19 Infection

- Shortness of breath
- Fatigue
- Chest pain
- Cough
- Fevers
- Arthralgia
- Myalgia
- Insomnia
- Dizziness
- Tachycardia
- Headaches
- Anxiety
- Depression
- “Brain fog”/cognitive dysfunction
- Stroke
- Blood clots – body, lung
Long Term Medical Consequences of COVID-19

Non-Specific
• Post-ICU Syndrome (PICS)
  • Cognitive dysfunction
  • Functional dysfunction
  • Pain
  • Depression
• Exacerbation of pre-morbid chronic conditions

COVID-19 Associated
• Renal
• Pulmonary
• Cardiovascular
• Neurological, Cognitive
• Psychological
• Autoimmune, muscular and joint
• Post-viral fatigue
Post-ICU Syndrome (PICS)
20-40% COVID-19 Patients had ARDS; High Mortality

• ↓ physical function 20-80%
  • ? Inflammatory cytokines
• ↓ cognitive function < 80%
  • Improves, can last 5 yrs
• Psychiatric
  • PTSD 50%
  • Anxiety
  • Depression

• More rapid resolution with
  • Higher educational attainment
  • Lower frailty

Other causes excluded.
Persists 3-6 mo. to years.
One third never return to work.
One Theory: An Autoimmune Response

- Most infected with COVID-19 develop a strong T cell response (CD4 & CD8), some have a “memory phenotype” leading to potential longer-term immunity.
- Some may have an altered response where “innate” molecules initiate the immune response causing an autoimmune or inflammatory syndrome.

Organ-based Chronic COVID-19 Syndromes

Pulmonary
- Chronic short of breath
- →, ↓ Exercise tolerance
- Restrictive (fibrotic) dz
- Interstitial disease

Cardiovascular
- Myocarditis
- Arrhythmia - autonomic dysfunction: “POTS”-like
- Thrombotic syndromes

Autoimmune
- Fevers
- Arthritis
- Fatigue
- Muscular pain
- Multisystem Inflammatory Syndrome (peds, adults)

Renal
- 37% CKD persists
- 31% on RRT at discharge
- New ESRD

Neurologic
- Headache
- Cognitive impairment “fog”
- Stroke
- “Myalgic encephalitis-Chronic Fatigue – Like” Syndrome
- Vertigo
- Anosmia, aguesia
- Psychiatric – anxiety, depression, PTSD

Any of these syndromes can cause disability.
Prevalence, persistence, treatments and severity remain unknown.
Myocarditis and Chronic Post-Acute COVID-19

MRI study:
100 pts. 71 (64-92) days after COVID-19, no symptoms, 53% male, age 49 (45-53), 67% home ill, 33% hosp. → 60% showed ongoing myocardial inflammation

COVID-19 Autopsy Study
277 autopsies, med. Age 75, 97.6% co-morbidities
Initial review: 7.2% myocarditis, most not functionally significant
Second review: Prevalence <2%

Unclear if myocarditis persists


Halushka MK. Cardiovasc Pathology
doi.org/10.1016/j.carpath.2020.107300
One Year Disability from Chronic COVID-19-Associated Heart Disease

Heart Disease & Disability (Blue Book)
- Chronic heart failure ✓
- Ischemic heart disease
- Recurrent arrhythmias ✓
- Symptomatic congenital heart dis.
- Heart transplant
- Aneurism of aorta or branches
- Chronic venous insufficiency ✓
- Peripheral arterial disease ✓

Post-Acute COVID-19 Heart Disease?
- Myocarditis ? → fibrosis → cardiomypathy, chronic heart failure
- Other cardiomyopathy ? → CHF
- Arrythmias, “POTS-like disease”
- Venous thrombotic disease → Chronic venous insufficiency
- Arterial thrombotic disease (PAD)

Chronic COVID-19-associated Cardiac causes and ages of disabled likely similar to other causes of the same syndromes
Return to Work Predictors with Heart Disease
(angina, MI, valvular, congenital, arrhythmias, pericarditis, endocarditis)

Predictors of RTW
• Self-rated health
• Symptom-free after surgery
• Attend cardiac rehabilitation
• Treatment (PTCA vs. CABG and SV)
• Health locus of control
• Physical health
• Treatment (PTCA vs. CABG and SV)

• Working class (white collar)
• Socioeconomic status (high)

Barriers to RTW
• Comorbidity
• Duration of Disease
• Depression
• Anxiety
• Disease severity
• Length of stay in hospital
• Age (older)
• Education (low)
• Gender (female)
• Residence (rural)

Do these apply to myocarditis/heart failure and arrhythmias from COVID-19?

Mood Disorders and Disability

**Time to Disability Following Diagnosis of Mood Disorder**

Canadian population-based data

Disability outcomes:

- long-term inability to work
  adj. hazard ratio, **2.03** (95%CI, 1.95-2.11)
- long-term care admission
  aHR, **2.20** (95%CI, 1.80-2.69)

Incidence and persistence of mood disorders after COVID-19 is unknown, but appears common – need further data.

Myalgic encephalomyelitis/chronic fatigue syndrome (ME/CFS)

**Symptoms**
- Chronic fatigue
- Post-exertional malaise
- Insomnia, pain, thinking and concentrating problems, dizziness
- Functional impairment; some house- or bed-bound

**Epidemiology**
- All ages, majority 40-60 yrs
- Women > men
- White > nonwhite
- 836,000 - 2.5 M US affected
- Most undiagnosed
- Cause unclear

*Is the Post-COVID-19 fatigue similar to this syndrome? Will it resolve? Uncertainty regarding percentage will go on to disability.*

https://www.cdc.gov/me-cfs/about/index.html
Who has Chronic COVID-19 Syndromes?

Current Sources of Epidemiology and Prevalence:
• Social media reports
• Medical Literature up to 6 mo. followup

Current data have inherent biases due to:
• access to healthcare
• regional demography
• socioeconomic circumstances
• Reporting

Many broader studies are underway.
Who has Chronic COVID-19 Syndromes?

*Acute* Covid-9 has disproportionately affected those who are or have:

- learning disabilities, mental health problems
- older and frail, nursing home residents (8-13x hosp. risk)
- chronic disease (3-5X hosp. risk)
- black, asian & other minority ethnicities (1.3-5.3X hosp. risk)

*We do not know if these populations have an increased risk of ongoing symptoms or chronic COVID-19.*

Social Media Patient-led Research: “Long Haul” COVID-19

Slack

**BODY POLITIC**

- 640 responses
- 72% US, 76% White, 4% hosp.
- 58% pre-existing conditions

Persistence of Symptoms

Number of Participants who had Reached Week x (1-8) In the Survey

https://www.wearebodypolitictic.com/covid19  Data Published May 11, 2020
Who Has Persistent Symptoms after COVID-19

UK: after hospitalization
• 163 pts; 141 @ 28 days followup
• median age 60, 56% male
Persistent symptoms @ 8-12 wks by WHO criteria
  • 16 (59%) mild (no O\textsubscript{2} req.)
  • 49 (75%) mod. (O\textsubscript{2} req.)
  • 16 (89%) severe (ICU, HF, or intubation)

Paris
• women (sex ratio 4:1)
• ~ 40 yrs old
• no relevant medical history
• few biological abnormalities
• Few +PRP; 50% Abs +

Arnold D. https://doi.org/10.1101/2020.08.12.20173526. posted 8/14/2020

Long-Term Care Cases Make Up A Smaller Share of Cases Now Than Earlier In The Pandemic

Long-Term Care Coronavirus Cases as a Share of Total Coronavirus Cases

NOTES: Denominator is based on number of states reporting each week. The number of states included in each week’s calculation of share of cases varies from 24-35 states. Data is available for <10 states prior to April 19th, so a national share of cases was not calculated for those weeks.

SOURCE: KFF analysis of available state reports, press releases, official state data from news reports, & The COVID Tracking Project.
My Guess - Who will have Chronic COVID-19?

- Middle-aged – later 50s
- Female predominance
- Across all severity groups, but greater prevalence in those with moderate or severe disease
- Includes those with PICS rather with COVID-19
- Includes those never tested but had symptoms

*The risk factors for **developing** Chronic COVID-19 Syndromes are not the same as that for **acquiring** COVID-19.*
Lessons from SARS (2002) and MERS (2012)

- Bodily Pain
- Perceived general health
- Physical functioning
- Social functioning
- Physical role limitations
- Emotional role limitations
- Mental Health
- Vitality

SARS 2003: Return to Work One Year Later

Study Population
• 117 SARS pts Canada
• med. age 42
• 67% women
• 65% health care workers
• 115 hosp. (mean LOS 14 d)
• 16% ICU (mean LOS 10 d); 9% mech. Ventilation

<table>
<thead>
<tr>
<th>Status</th>
<th>N = 107</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full time work</td>
<td>71 (66%)</td>
</tr>
<tr>
<td>Pre-SARS work</td>
<td>79 (74%)</td>
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<tr>
<td>Not returned to work</td>
<td>18 (17%)</td>
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</tbody>
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• 23 returned FT with no modifications
• Those requiring modifications took 93 days (ave.) to return to FT

Health Care Utilization

- Intense specialized rehabilitation 9/117 patients
- Hospital program 20 pts, ~ 11.5 visits
- Private OT/ PT 20 pts, 28.6 visits
- Home Rehab 2pts, 6.0 visits

Emotional

- SF36 domains 0.3 - 1.0 SD below normal

Pulmonary/ Physical Function

- Most normal lung function
- ICU patients:
  - restrictive disease @ 6mo.; resolved by 1 yr
  - Very similar to other ARDS pts
- Exercise capacity:
  - 18% w/ clin reduction in 6-min walk
  - Many report shortness of breath and fatigue contributing to exercise limitation

Predicting Rates of Disability

- Syndrome-driven disability (PICS, organ-system diseases [e.g. ESRD]) likely similar to chronic COVID-19 syndromes; disability rates known;
- Autoimmune syndromes uncertain, likely to increase disability
- Middle-aged population affected by chronic COVID-19 syndromes likely increase those on disability/SSI prior to age 62
- Mortality in aged 75+ or in congregate living will decrease the numbers receiving social security.
What are Implications of Post-acute COVID-19 Syndromes for Disability?

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<thead>
<tr>
<th></th>
<th>US Current %</th>
<th>Chronic COVID-19 Impact in adults &lt; 62</th>
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<tbody>
<tr>
<td>Mobility</td>
<td>13.7%</td>
<td>↑</td>
</tr>
<tr>
<td>Cognition</td>
<td>10.8%</td>
<td>↑</td>
</tr>
<tr>
<td>Independent living</td>
<td>6.8%</td>
<td>↑</td>
</tr>
<tr>
<td>Hearing</td>
<td>5.9%</td>
<td>?</td>
</tr>
<tr>
<td>Vision</td>
<td>4.6%</td>
<td>?</td>
</tr>
<tr>
<td>Self-care</td>
<td>3.7%</td>
<td>↑</td>
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The Road Ahead

• Define the pathophysiology and clinical course of post-COVID-19 syndromes
• Identify who is at risk
• Prevent and treat chronic COVID-19 syndromes
• Assess and address increases in related disability